- ERRATA -

FRDA Report 172 A Method for Monitoring Wildlife in Managed Forests:
A field manual.

The following species codes given in Appendix 3 are incorrect:

p. 52 - Species No. 241 - Common Tern: code CMTE should read COTE.

p. 54 - Species No. 435 - Green-tailed Towhee: code GGTO should read GTTO.
- Species No. 452 - Song Sparrow: code SPSP should read SOSP.
- Species No. 463 - Lapland Longspur: code LALU should read LALO.
- Species No. 518 - Southern Red Bat: code LABO should read LABL.

If the incorrect codes are used, the species involved will not appear in data generated by the automated data summary system.

FRDA Report 172

A Method for Monitoring Wildlife in Managed Forests A Field Manual

(First Approximation)

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PREFACE

The Wildlife Program applauds the initiative shown in developing this methodology for directly monitoring wildlife in managed forests. The Wildlife Program has a number of standard methodologies for population inventory. These are primarily in support of population management objectives related to harvesting regulations or focused on species of management concern, such as threatened and endangered. There are also methodologies for conducting biophysical habitat inventory, and establishing provincial capability and suitability ratings for habitat. The Wildlife Program, together with the Ministry of Forests, has also developed the manual entitled, "Procedures for Habitat Monitoring."

For some time there has been the recognition of the need for direct monitoring of wildlife species at the forest stand level. In the past, wildlife habitat use has been primarily interpreted from levels of habitat utilization by a few species of management concern. The development of this direct field monitoring technique for all species is an important step towards understanding the effects of forest practices on all wildlife species. This field technique promises a new standard tool by which to gather new wildlife information and so better support integration of wildlife into the management of forests.

We recognize the interim nature of this methodology and anticipate improvements and further involvement once it has been field tested.

R. Halladay
Acting Director
Wildlife Program
B.C. Environment

July 1991

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1 INTRODUCTION

Successful practice of integrated forest management requires detailed knowledge of the characteristics and interactions of the resources involved, and an understanding of how various management practices affect them. In response to the need for obtaining better information on the relationship between wildlife and silviculture in northern British Columbia, FRDA project 1.49 was set up to develop a simple and practical wildlife monitoring method. This document is for use in the field as a procedures manual and reference for that method. A short training video is also available, and is recommended for first-time users.

The terms "wildlife monitoring" and "environmental monitoring" have distinct meanings in this document. The former refers to the procedures described herein; the latter, focussing on physical and vegetative habitat features, refers to the monitoring system developed jointly by the B.C. Ministries of Environment and Forests (Habitat Monitoring Committee 1990). The wildlife monitoring method and associated data forms have been designed to be compatible with those for environmental monitoring.

A detailed account of the rationale and development of the wildlife monitoring method, together with examples of its use and a literature review, are provided in a separate report.[1] Some essential points about the method's application and limitations are noted here:

- It provides reconnaissance level information on wildlife occurrence. It is not intended to replace formal research on forest ecology matters, although results are expected to be useful in indicating information gaps and identifying future research projects.
- It is useful for comparing two or more areas, such as treatment and control sites or different habitat types, or for monitoring changes in one area over time.
- It is not appropriate for very small research or treatment plots. Firm guidelines on the minimum size of potential project areas are not yet possible, but will probably relate to home range sizes of common wildlife species.
- Results from the method will be most meaningful if they can be correlated with vegetation or other habitat data. Companion environmental monitoring studies are therefore recommended.

2 FIELD PROCEDURES

The basic technique requires a person to walk along a pre-selected line (transect), recording direct contacts with wildlife and indirect evidence of wildlife occurrence (i.e., "sign" — droppings, tracks, trails, burrows, nests, and various kinds of feeding remains). The data gathered this way may be augmented on some transects with results from a small mammal snap-trapping session (see Section 2.5) and a herpetofauna search (Section 2.6). There are two variations of the transect methodology: the first one involves the use of a two-person team; the second is designed to be accomplished by one person. Both are described in following sections. The pros and cons of these two variations are provided in Hatler.[2]

The best candidates for conducting these wildlife transects are people with a strong outdoor orientation, able to venture away from established trails and to maintain concentration in the face of such adversities as biting insects, devil's club, deadfall, and wet feet. Some natural history background at either the amateur or professional/technical level is desirable (the more the better), particularly in the one-person method and for at least one member of a two-person team. Some ability in basic compass navigation is also important. However, any outdoor person who is alert, observant, and sufficiently interested can acquire an adequate skill level in these matters, either in a short training session or while working with a more experienced individual.

---

[1] Hatler, D.F. 1992. Development of a method for monitoring wildlife in managed forests. B.C. Min. For., Prince Rupert Forest Region, Smithers, B.C. Draft manuscript.

[2] Ibid.

2.1 Two-Person Method

2.1.1 Equipment list

Required: map/aerial photo showing transect location and layout, prepared sample rope (see Fig. 1), compass, metric ruler or tape measure, plastic bags, labels, field manual, pencil, and data forms.

Optional: extra section of rope (10–15 m), binoculars, camera, small mammal snap traps, and bait (Section 2.5).

2.1.2 Mechanics

The primary sample units are 10-m segments along the transect line, as defined by a rope stretched between the two team members. The principle of operation is best described for the case in which the rope, with a loop at one end and a spike attached at the other (Fig. 1A), is exactly 10 m long. To begin observations along a particular line segment, the observer secures the spiked end of the rope to the ground (loosely, and angled forward so that it can be removed easily from a distance later), and then proceeds along the rope toward the recorder, calling out observations which are entered by the recorder on the prepared data forms. When the observer reaches the recorder (completing the 10 m line segment), he or she establishes the next segment by tugging on the rope to release the spike, pulling it forward, and re-setting it at the position last occupied by the loop end. The recorder then moves forward with the loop, guided verbally by the compass-bearing observer to maintain a straight line on the correct bearing. The transect is therefore performed step by step, one segment at a time.

In practice, except in uniformly thick cover, it is generally more convenient and efficient to use a rope that is 20 m long from spike to loop, clearly marked at the 10-m midpoint (Fig. 1B). In open terrain, it then becomes possible to survey two segments on a single setting, saving time. In local patches of thick cover, the recorder may stop at the 10-m marker for the first survey segment on a particular setting, and not move to the 20-m end of the rope until after that first segment has been completed. In such cases, referring back to the trailing (first segment) end, which is still secured by the spike, may help the observer keep the recorder on a straight course.

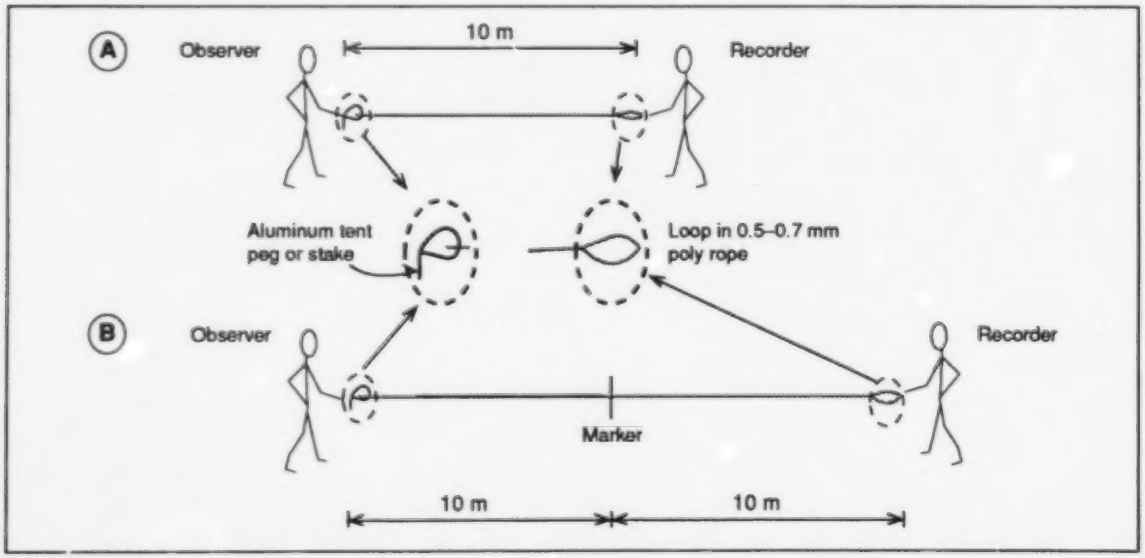

FIGURE 1. The basic 10-m sampling rope (A) for the two-person method, and the 20-m rope for use in open terrain (B).

2.1.3 Transect width

For inanimate sign detected along the transects, the effective strip width is 2 m — 1 m on either side of the line (Fig. 2A). The observer can carry a tape or metre stick and measure to items of questionable position, although that may be unduly cumbersome in areas characterized by a high density of either wildlife sign or surrounding woody vegetation. A more practical alternative is to determine the size of a 2-m strip width in relation to one's armspan, and to make judgements on whether to include observed items on that basis.

For direct contacts with live animals, an effective strip width of about 20 m applies — 10 m on each side of the transect line, estimated rather than measured (Fig. 2B).

2.1.4 Other considerations

Identification of wildlife and sign: In most areas, a few kinds of sign will predominate along the transect and most others will occur only rarely. The common ones are quickly learned in a short training session, but even many of the rarer ones, once learned, may become routine. The first transects undertaken by new observers, or by experienced observers in new areas, can and probably should take longer than those done later.

The simplest method for identifying unknown sign is to consult someone who does know. That can be done by bringing back a sample or photograph, by providing an adequate description, or by marking the location and taking the "expert" back later for consultation. In some cases, the only available authority may be written reference material. The main drawback to such references, including the various "field guides," is that they cannot anticipate and portray all of the variations and contexts in which a particular kind of sign may appear in the field.

The best guide I have seen for identification of tracks and droppings is Halfpenny and Biesiot (1986), and the only other one worth mentioning at this time is the first ever produced on the subject (Murie 1954). Little is available for most other kinds of sign, although Harestad *et al.* (1986) provide useful descriptions and line drawings of wildlife damage to trees, and Harrison (1978) is *the* reference for bird nests and contents. In some cases, it is possible to confirm identification for sign by reading life history accounts on "suspected" species in general references such as Godfrey (1986) for birds, and Banfield (1974) or

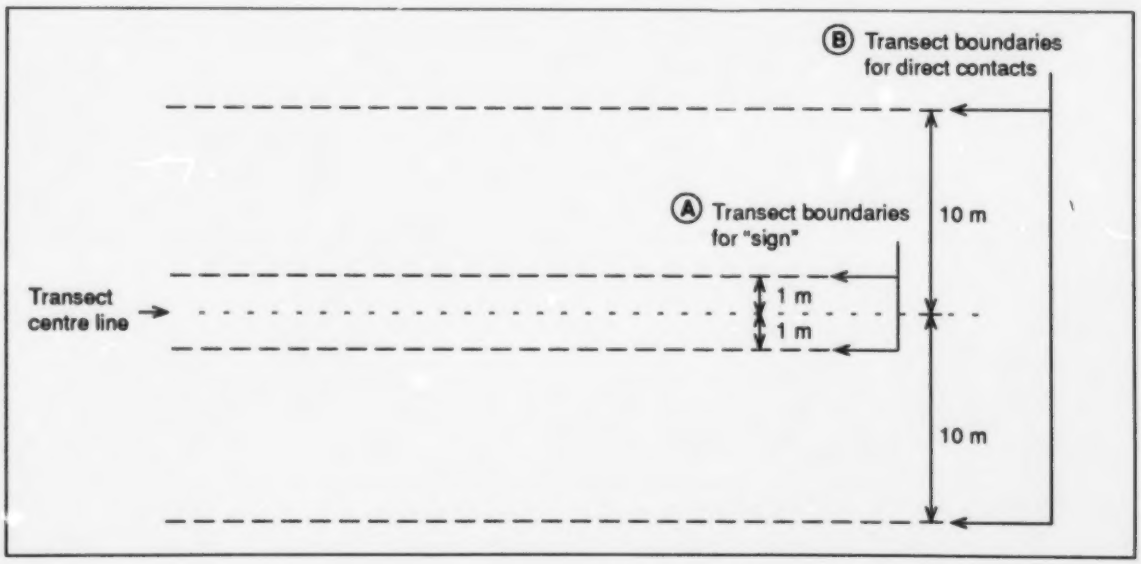

FIGURE 2. Transect width for inanimate sign (A) and for direct contacts with live animals (B).

Chapman and Feldhamer (1982) for mammals. For example, if you suspect that a stick nest in a tree may be attributable to a red squirrel, read the account for red squirrel in one or more such references and compare their descriptions with that for the "unknown."

There are numerous guides to the identification of animals seen directly. For birds, these include (listed in my personal order of preference) National Geographic Society (1987), Robbins *et al.* (1983), and Peterson (1961). The most used mammal field guide comparable to those listed above for birds is that of Burt and Grossenheider (1976). However, despite illustration deficiencies, Cowan and Guiguet (1973) is probably the most useful for workers in British Columbia. The Royal British Columbia Museum publications on amphibians (Green and Campbell 1984) and reptiles (Gregory and Campbell 1984) are recommended for identification features, distribution, and life history information on members of those classes of vertebrates in the province. Recordings of the "typical" songs of birds are also available (e.g., "A Field Guide to Western Bird Songs," published by the Laboratory of Ornithology, Cornell University, Ithaca, N.Y., and "Nature Sounds of the Northwest," by P. Ward and K. Hall, Total Recording Co., North Vancouver, B.C.)

Most mammals are nocturnal or crepuscular and are not commonly observed during the times of day when most transects are conducted. Those that *are* seen are likely to be the common, easily identifiable ones. In the case of birds — most of which are active by day — observers with little training will have difficulty identifying many of them, even with the best field guide. Because reference checking can be costly in time and impractical in some weather conditions, and because most of the data on the transects are expected to come from observations of "sign" rather than live animals anyway, I recommend that transect personnel not try to carry all potentially relevant guides in the field. Rather, these people should cultivate the habit of recording thorough descriptions, which can be reviewed at greater leisure later, in the office. Following are some of the features that can be included in such descriptions:

For mammals:

- Size – usually expressed in relation to common species (e.g., mouse-size, squirrel-size, hare-size, coyote-size . . .).
- General Body Shape – short and stout; long and thin . . .
- Colour – basic colours/shades, and distinctive markings.
- Tail Characteristics – long and bushy; long with short hair; broad, flat and hairless; tail not evident . . .
- Aspects of Behaviour and Habitat – climbing, swimming, gait, escape cover or structure (e.g., ground burrow, hollow log, water body).

For birds:

- Size – sparrow-, robin-, crow-, eagle-size.
- Shape – short and compact; long and slender . . .
- Leg Length – long or short.
- Bill Length and Shape – long down-curved; long straight; short thick; hooked . . .
- Colour – include reference to basic background, legs and bill, and markings (e.g., brown on back, white on belly with brown streaks, yellow legs and bill).
- Distinctive Structural Features or Colour Markings – (e.g., forked tail, crest on head, iridescent blue patch on wing, red patch on crown, two white wing bars, black and white lines above the eye, light ring around the eye).
- Habits – (e.g., scratching among leaves on the ground, catching insects in the air, perched on a power line, diving for fish . . .).
- Songs/Calls – (e.g., regular three-note calls that sounded like "ki-ki-ki").

For amphibians and reptiles:

- Size – total length, usually estimated but measured if animal can be caught.
- Shape – short and compact; long and slender . . .
- Leg Length – long or short (measured if animal in hand).
- Colour – basic colours/shades, dorsal and ventral if both are observable, and distinctive markings.
- Tail Characteristics – especially length in relation to the rest of the body.
- Distinctive Structural Features – (e.g., spines, long nails, gills, crests, hoods).
- Aspects of Behaviour and Habitat – climbing, swimming, speed of movement on the ground, escape cover or structure (e.g., hollow log, rock crevice, pond).

If a family or generic designation is obvious, that should be noted. It is easier to determine the identity of "a black woodpecker with a white patch on the back and small yellow patch on the crown" than "a black *bird* with . . ."

Collection of biological samples: Most sign is best identified in the context of its local occurrence. However, some "unknowns" may be sufficiently diagnostic and transportable to be worth carrying back to the lab (or the resident expert). Included in that category are intact animals, hair, feathers, bones (especially skulls), and some feces (especially hard pellets). Soft feces are likely to lose their form after being carried all day in a plastic bag at the bottom of the pack, and will be less identifiable in the lab than they were in the field. Note: Handling of fecal material, particularly that from members of the dog family, can result in serious diseases. The safest way to collect feces is to invert the plastic bag over the hand, grasp the sample through the bag, then turn the bag back over the sample so it is enclosed without having been touched directly.

Collected samples should be bagged separately, each with a label bearing the Project ID Number, Transect ID letter, and sample unit (segment) number (e.g., R010001-A-27 would indicate segment 27 in Transect A, Project R010001). Data forms should be filled out as for other observations (i.e., taking identification as far as possible), and the existence and context of the collected sample should be indicated in the "Remarks" column or the Incidental Observations and Notes Form (WM-3).

Photographic evidence: Good quality photographs can be an acceptable substitute for biological samples, and may be the only alternative for bringing less transportable items (e.g., soft droppings or distinctive marks on a tree trunk) back for identification. However, weather and light conditions may often preclude the acquisition of usable photos. This alternative is for inanimate sign only, using small focal length lenses. It would not be practical to carry the kind of equipment or take the time required for photography of live animals along the transects. When photographs are taken, some consistent indicator of size should be included. A 15-cm ruler is recommended for small items, while including the other team member in the picture may serve to provide perspective for larger items. As with collected samples, entries on data forms should be as for other observations, and the existence of photos should be indicated in the "Remarks" column or on Form WM-3.

Alternation of duties: The observer/recorder roles may be permanent within a particular team, if the two members are satisfied that such an arrangement will produce the best results. However, I recommend that they alternate between the two roles periodically, so that each gains a better appreciation for the needs of the other, and so that the mental "fatigue" that often accompanies repetitive chores can be prevented.

Collaboration: In some cases, the observer may request assistance from the recorder in identifying or classifying some natural history item. In such instances, where it becomes necessary for the recorder to temporarily leave his or her post at the end of the segment, he or she should fix the location of the rope by jabbing a stick through the loop, or weighting it down with a large stone. In addition, the recorder — as the first to pass along the transect — is likely to be involved in most direct contacts with live animals, and should remain alert for certain kinds of sign. He or she can make a mental note of items seen as the

line is being set, or signal the approaching observer. For example, the observer's attention may occasionally become so riveted on one plane of observation (e.g., on the ground), that he or she fails to see conspicuous items in another plane (e.g., a nest in a tree).

Rope length: In general, a rope capable of a setting involving more than two segments (i.e., 30 m or more) is not recommended. The longer the rope, the more subject it is to tangles and snags, and the longer it takes to walk back and free it. A longer distance between observer and recorder may also affect survey accuracy, by making vocal communication between the two more difficult and thus the opportunity to confer on the identification of new and unusual sign impractical.

Rope height: The best policy is to keep the rope as close to the ground as possible, to enable the observer to straddle it and work along the transect centre. This can be accomplished in most cases by passing the rope under shrubs and low branches rather than over them. In some cases, such as in an area of extensive deadfall, travel along the line will necessarily be above rather than on the ground, and the most practical location for the rope would be at that higher level.

Speed of movement: The forward progress of the observer is affected primarily by the density of vegetative cover and the frequency of wildlife sign. A 10-m segment devoid of sign and in open conditions may be completed in less than half a minute, while one in thick cover or with an abundance of sign may take 2–3 minutes. The average for most situations will be about 1 minute.

Obstacles: Occasionally the bearing for a transect will lead to a major obstacle such as a sheer cliff or a pond. Completing segments and maintaining the bearing in such cases may take some ingenuity. Some useful techniques include (a) weighting the loop end of the rope and throwing it across the obstacle, for retrieval on the other side; (b) temporarily attaching another rope to provide sufficient length to get around an obstacle; and (c) establishing the transect location by extending a long, marked pole as a kind of transit marker behind a high obstacle.

For smaller obstacles such as tree trunks or large boulders, a small detour may be necessary, but the original line of travel should be resumed as soon as practicable. In some cases, where the object obviously also represents an obstacle to wildlife movement at that location (e.g., the tree trunk), it may be appropriate to count sign within the detour as part of the total for the transect segment, even though it may be slightly more than 1 m off the true centre line. This is a judgement call, and is applicable only to small obstacles. Larger obstacles may make particular segments unrepresentative of the habitats in which they occur, and require description under "Remarks" on the data form, or on Form WM-3. For example, such an entry might note that "the first 7 m of the segment is pond surface."

2.2 One-Person Method

2.2.1 Equipment list

Required: map/aerial photo showing transect location and layout, hip chain and spare string, compass, metric ruler or tape measure, plastic bags, labels, field manual, small tape recorder, and spare batteries.

Optional: binoculars, camera, small-mammal snap traps and bait (see Section 2.5).

2.2.2 Mechanics

The major difference between this method and that done by the two-person team is that the single observer cannot make efficient use of either the prepared data sheets for note-taking or the rope system to mark the transect line and define segments, because frequent stops, movements back and forth along the line, and continual breaks in concentration would be required. Rather, the one-person system involves the use of a compass to maintain the transect line, a hip chain to document the position (distance, in metres) of each natural history observation along the line, and a hand-held tape recorder to log and store the data. The transect width is the same as that described above for the two-person method

(Section 2.1.3). To illustrate the form of the data recorded, the following is a portion of a transcript for one transect in the FRDA 1.34 study area north of Prince George, 24 May 1990. The numbers in parentheses are the distances (m) along the transect line, as read from the hip chain:

> "... moose browsed shrub—willow, heavy (622), vole burrows and runways (628,636,651), fresh (warm) bear scat (708), moose pellets (840), vole burrows and runways (874,891,912), pair of anxious Common Snipes—nest nearby? (924) ..."

Such data may be made more compatible and comparable with the two-person results by being transcribed and transferred to the prepared data sheets as described in Section 4.

2.2.3 Other considerations

The points relating to identification, sample collection, and photographic evidence for the two-person method, above, also apply here. The one-person method is the faster of the two, since it does not require stopping to deal with rope setting. Even note-taking with the tape recorder may be accomplished while the observer is on the move. Only brief pauses to consult compass and hip chain are required. However, undue concentration on one responsibility (e.g., maintaining the compass bearing) may detract from others (e.g., searching for wildlife sign in one or more planes of observation). An experienced and disciplined observer is required.

Uses: The one-person method is useful in reconnaissance of areas proposed for more intensive wildlife or environmental monitoring projects, and is the method of choice for winter work (snow tracking, see Section 2.4).

Obstacles: The points made for the two-person system also apply here, except that the hip chain string rather than a rope serves as the primary reference for re-orientation to the transect line.

Note-taking: There are several advantages to the use of a tape recorder for this purpose, particularly in foul weather, but there are also some potential pitfalls. Notably, data are being lost and effort wasted when one is speaking into a tape recorder that is not recording. The following points of advice apply:

- Become intimately familiar with the machine and its controls, particularly the relationship between "record" and "pause." Do this before, rather than during, the first field work session.
- Test batteries daily; mark and use older, lower power batteries only for transcribing (if at all) and save the strongest ones for field use.
- In the field, test the machine regularly to confirm that notes are being fully recorded. Note: On some machines, there is a time lag between switching on and actual tape movement, so that speaking into the machine too soon results in failure to record the first part of the taped message.
- Test the machine whenever it is bumped or dropped.
- Transcribe daily. That is the best way to ensure that a previous day's notes are not being lost as a result of taping today's notes on top of them.
- Keep the machine in a small plastic bag during wet weather. It can be used without removing it from the bag. Under very cold conditions, keep the machine warm (e.g., inside your coat) between uses.

2.3 Transect Planning

For the purposes of scheduling and layout, several features and considerations are common to both one- and two-person surveys. These points may be of interest primarily at the supervisory level.

2.3.1 Seasonal timing

There are two broad seasons for conducting the surveys, as distinguished by the presence or absence of snow cover. Many wildlife species in British Columbia, including several of high social or

economic importance, are secretive and inconspicuous in the field, and their presence and distribution may be best detected by snow tracking. This is particularly true for many of the carnivore furbearers. However, successful snow tracking requires specialized knowledge and experience, and particular survey conditions. Also, access to potential study sites may pose a problem in many areas in winter. Overall, the transect work is probably best suited for the seasonal work force that becomes available in summer. Thus, it is assumed that most users of this manual will be operating during the snow-free season, and snow tracking is dealt with only briefly as a special case (Section 2.4).

Within the context of "summer" surveys, the best time in most areas will actually be in spring, between the end of snow melt and full leaf-out of local shrubs. That timing will vary between areas and years, but will be in about the last half of April through the end of May in most areas of interest to foresters in the northern half of the province. The main potential constraints to consider are:

1. navigation, movement, and observation are considerably more difficult in thick shrub cover that is in full foliage.
2. observation of ground sign may be virtually impossible once a thick ground cover of annual herbaceous growth has taken hold.

Some dry, sparsely vegetated sites may be workable longer, or even throughout the entire snow-free season.

Spring surveys mostly sample sign that has accumulated over an unknown period. However, much of the ground level sign will be attributable to the most recent winter. Included in that category is sign found lying on top of the previous year's snow-flattened annual growth. Although spring surveys are best for most kinds of inanimate sign, they are too early to provide for potential contact with some migrant birds, and to yield best results from small mammal traplines. Thus, early to mid-summer work may be advisable instead of, or in addition to, spring surveys in some areas.

2.3.2 Transect selection

A number of factors have to be considered in the establishment of transects. Access and terrain features may dictate the transect's orientation, or they may be selected directly from maps or aerial photos to enable optimal reconnaissance or sampling of proposed development areas, habitat units identified in an environmental monitoring project, or a series of representative habitats.

Even if the transect data are being gathered primarily for descriptive purposes, statistical comparisons may also be desirable. Therefore, transects should be located randomly (or systematically with a random starting point) along some baseline in or through habitat units and habitats of interest. Although it is occasionally possible to run a long transect from one access point to another, it is usually most practical to plan for a series of two or more transects that bring the survey team back to the original access (Fig. 3).

2.3.3 Transect numbers and length

This aspect of the transect methodology is still evolving, and will require experience in a variety of habitats and circumstances before clear guidelines can be established. The number of transects required for any particular habitat or set of habitats depends on a number of factors, including the size of the habitat blocks involved, the abundance and distribution of wildlife sign within those blocks, and study objectives. At least two transects are generally required to enable an assessment of data representativeness and consistency. If the second is greatly different from the first, either in terms of adding new species or in density of sign within one or more of the sampled habitats, it may be advisable to continue until the data per habitat "stabilize."

The list of incidental observations (i.e., the number of species documented as present in the area, but not detected on the transects) needs to be considered in this context. For purposes of description or reconnaissance, two transects may be enough. If statistical comparisons are to be made, the required

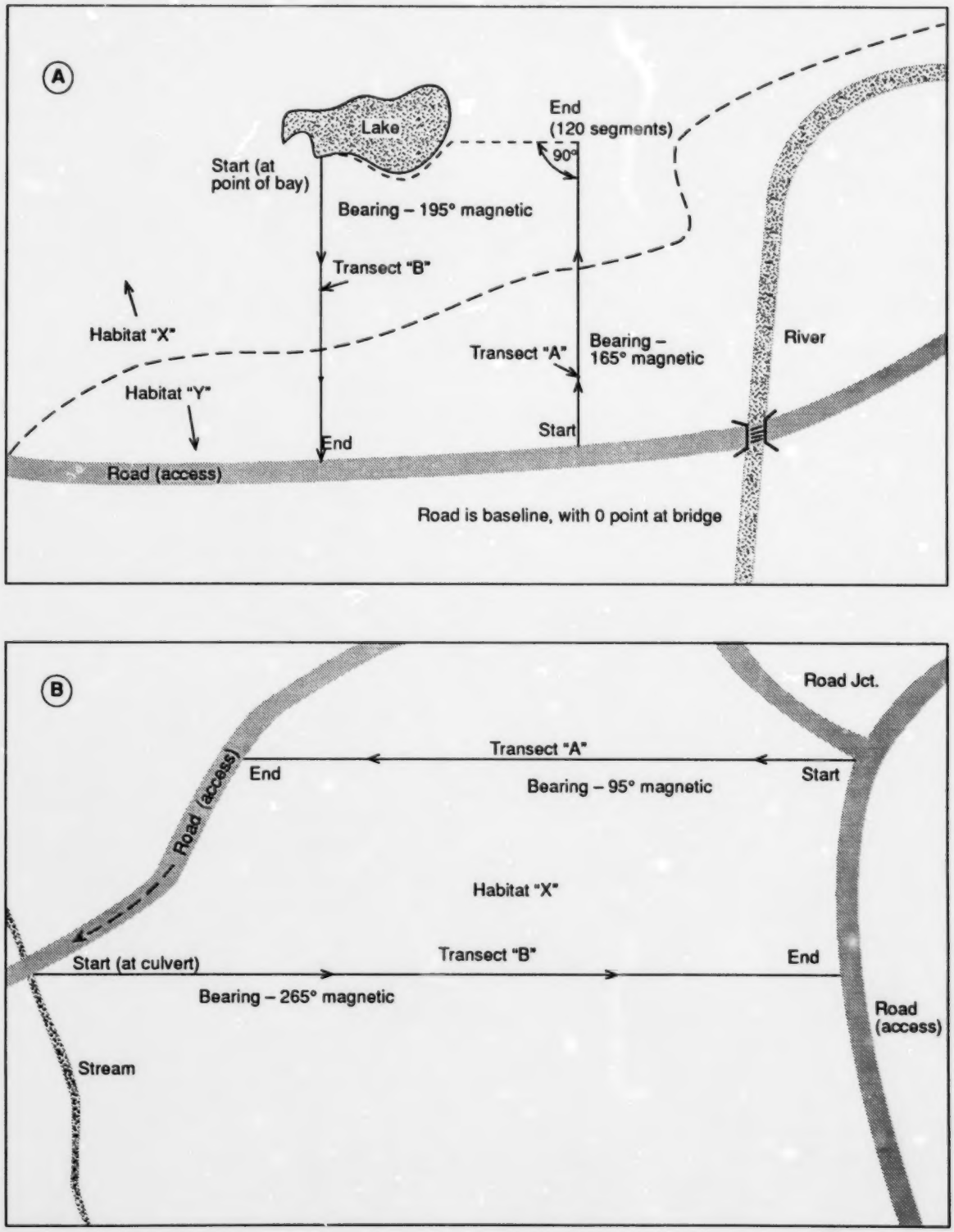

FIGURE 3. Examples of transect layouts in relation to access.

sample sizes (number of segments or groups of segments per habitat) will depend on the variability of data obtained on reconnaissance transects, with roughly equal sampling effort per habitat. A statistician or appropriate statistical text should be consulted.

In most cases, the length of a transect will be determined primarily by topography and the distribution of the habitats to be sampled. Sample size (number of transect segments) per habitat is a function of the length and number of transects through that habitat. For example, a sample of 400 segments in a pine stand might be attainable with a single 4-km transect through the stand if it is sufficiently large, or may require four transects each 1 km long.

Experience to date suggests that comparisons between adjacent habitats (including paired treatment/control blocks) at this reconnaissance level may best be done with transects that pass through both, rather than with separate transects only *within* habitats. For one thing, graphical depiction of wildlife sign along such transects may help define and separate "edge" occurrences from those truly attributable to the habitats under study. Edge effects are undoubtedly variable both for different species and for different habitat configurations, and therefore require careful consideration in both monitoring and research. Finally, where man-altered habitats constitute the study focus, transects should be extended into adjacent climax or predominant forest, to help establish context for the data obtained. For example, the absence of sign for a particular species within a managed habitat block may reflect a general absence or scarcity in the local area rather than an effect of management. Some examples of data output and presentation for transects in northern British Columbia are given in Hatler.[3]

2.4 Snow Tracking

Winter transects on snow differ from those made during the snow-free season in two important ways: 1) they focus to a greater extent on relatively recent sign; and 2) they involve animal tracks to a much greater extent. Those differences, together with the practical aspects of working outdoors in winter, dictate some special considerations.

2.4.1 General procedure

The two-person transect method is impractical for winter work for a number of reasons. It requires that both team members be standing still about half the time (the observer while the recorder is setting the rope, and the recorder while the observer is searching for sign along the line), making them more susceptible to cold than if they were moving more regularly. Furthermore, the sample rope tends to obscure sign as it is being dragged forward along the snow to set transect segments; and taking notes with paper and pencil is difficult with gloves or cold hands. I therefore recommend that the one-person method, and its specified equipment (Section 2.2.1), be used for winter transects. Additional equipment, either snowshoes or cross-country skiis, will likely be required for snow depths greater than about 40 cm.

With the one-person method for winter transects, data will be noted on a tape recorder and transcribed in the form shown in Section 2.2.2. Winter data may be of greatest interest when compared to summer results from the same area. They will therefore have to be converted and summarized by 10-m segments, as described in Section 4. Some examples of winter transect results, together with a discussion of the pros and cons of snow tracking work are given in Hatler.[4]

2.4.2 Personnel

Snow is an inconsistent tracking medium, varying in how it will register the tracks of any particular animal with differences in depth, density, and surface hardness. The appearance of a particular species' tracks on snow may also vary among different sex and age classes, and with differences in gait or activity. Finally, the appearance of tracks in snow changes over time, and those changes may occur relatively quickly, depending on air temperature and wind conditions. The good references on animal tracks, such

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[3] Hatler, 1992.
[4] Ibid.

as Halfpenny and Biesiot (1986) and Murie (1954), are useful for identifying tracks found in their "classical" form for particular species, but they do not portray all of the variations that may be encountered. Experienced observers are needed on winter transects.

2.4.3 Timing

Consideration of when to conduct winter transects has both seasonal and practical components. In relation to seasons, the actual or apparent animal use of a particular habitat may change as winter progresses. That change results from local immigration or emigration of individuals and species in response to snowpack differences between areas, increasing subnivean occurrence of some species (small mammals, some mustelids) as the snowpack increases or as temperatures drop, and winter mortality. An important point here is that results from late winter transects in one area are not legitimately comparable with early winter results from another. Furthermore, differences in snowpack patterns between years must be considered for comparisons within the same area.

Clearly, then, the seasonal timing of transects depends on objectives. Early winter surveys, before snow depths exceed about 20 cm and before the main onset of low temperature extremes, are likely to show the widest range of use in terms of biodiversity, since even the smallest species are still active on the surface. However, to account for seasonal movements in or out of the area by some species, surveys later in the winter may also be required.

Most snow tracking studies recognize that the time since last snowfall is an important consideration. If that time is too short, the animals may not have sufficient opportunity to get out and make tracks. If it is too long, the resulting accumulation of tracks will be unrepresentative for quantitative comparisons and may be biased against rarer species. For example, the tracks of a marten or fisher are difficult to distinguish in an area heavily tracked by snowshoe hares. Attempts to standardize strictly in terms of time, however (e.g., ". . . tracking studies were carried out three days after a fresh snowfall"), constitute an oversimplified solution. Strong winds on the last day of the prescribed interval may be more effective than another snowfall in removing tracks, and some species greatly restrict activity when temperatures are very low. Scheduling flexibility and good judgement are required to determine whether and when tracking studies should be undertaken.

2.5 Small Mammal Trapping

Small rodents (mice, voles) and shrews are prominent members of forest ecosystems from both wildlife management and forestry perspectives. In the context of biodiversity, each has its own particular value. In addition, most of these species serve as prey for other wildlife of interest to society (e.g., raptors and many furbearers), and many play roles in forest establishment and growth as agents of seed and spore dispersal, as predators on invertebrates such as certain insect "pests," and occasionally through depredations on seedlings or older trees. However, most small mammals are not particularly conspicuous and will not be adequately represented during transects focussing on visible sign. I therefore recommend that at least two transects in each project area include a series of snap traps to help describe occurrence and relative abundance of those species.

The procedural recommendations below are based on both relevant literature and practical matters. They represent a compromise between the level of study activity required for good research,[5] and, on the practical side, the increase in time and trouble resulting from adding the trapping component to the procedure.

2.5.1 Equipment and field procedure

Museum Special and Victor Holdfast snap traps are generally preferred for biological sampling, but the former are expensive and the latter are difficult to acquire. Thus, I recommend use of "standard" Victor mouse traps (the kind available in most hardware and grocery stores across Canada), modified to be more sensitive and efficient by the method shown in Figure 4. To reduce trap losses to small carnivores or to

[5] Hatler, 1992.

larger, non-target species (such as squirrels) that drag them away in temporary captures, traps may be secured with a short section of string attached through a hole drilled in one corner for that purpose. For bait, shelled walnut pieces are preferred. Peanut butter attracts small mammals equally well, but is often removed by ants and is sometimes licked off by small mammals without springing the trap. Other required materials include flagging tape to mark trapping locations, plastic bags and labels for trapped specimens, and a pair of needle-nose pliers to adjust trap triggers or effect repairs.

Traps are distributed in pairs at 50-m intervals along the established transect line, with the base location or "station" in the first 100 m selected randomly. If the random two-digit number is 50 or smaller, it becomes the first station; the second and subsequent stations are then at intervals of 50 m (e.g., 17, 67, 117, 167 . . .). If the random two-digit number exceeds 50, the first station is determined by subtracting 50, the drawn number becomes the second, and subsequent stations are located by adding 50 (e.g., for random selection of 83, the stations would be at 33,83,133,183 . . .). For transects involving small mammal traplines, a hip chain can facilitate the locating of these points, and the string can be useful for following on subsequent trap checks.

For maximum efficiency, traps should be placed at locations where small mammal activity is likely, rather than precisely at the randomly designated points. Thus, for the purposes of this work, each trap station is a 5 m diameter circle, centring at the randomly selected point on the transect centre line. The two traps for each station are placed, not necessarily together, at suitable locations such as obvious mammal runways and burrow entrances, sheltered places such as depressions under overhanging boulders or downed logs, and debris piles. The trap station centre should be marked with flagging tape; the two individual trap sites can also be marked if required (preferably with a different colour from that used for the centre). Figure 5 depicts the layout for the first example given above — that is, for the case in which the first trap station was selected to occur at 17 m from the start of the transect, and the second station at 67 m.

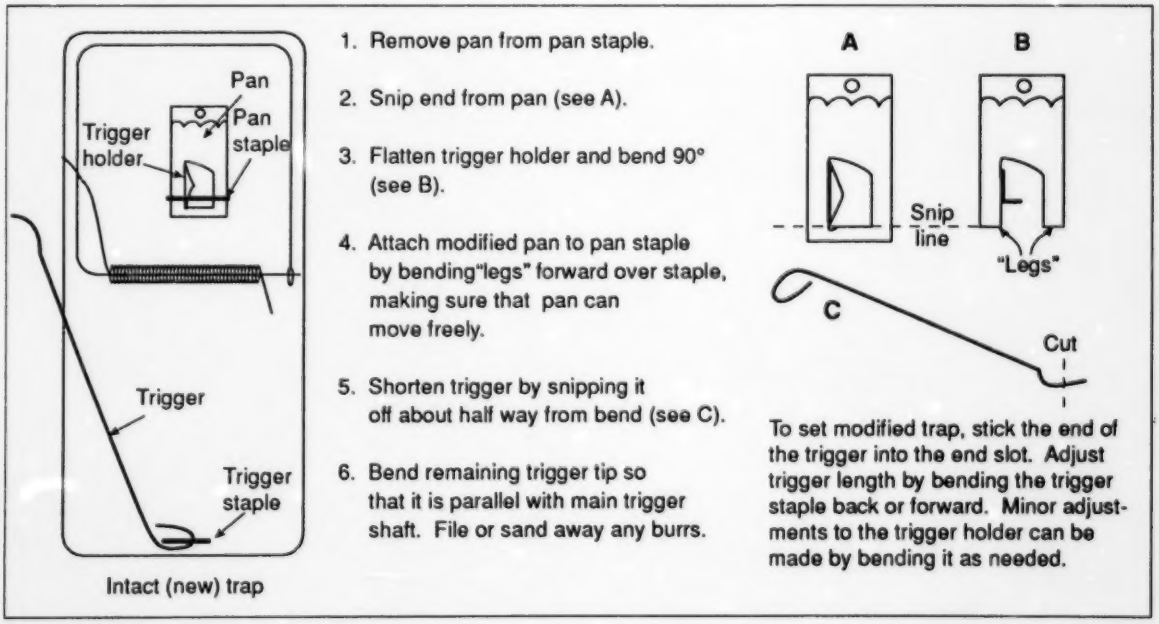


FIGURE 4. Modification of standard Victor snap traps.

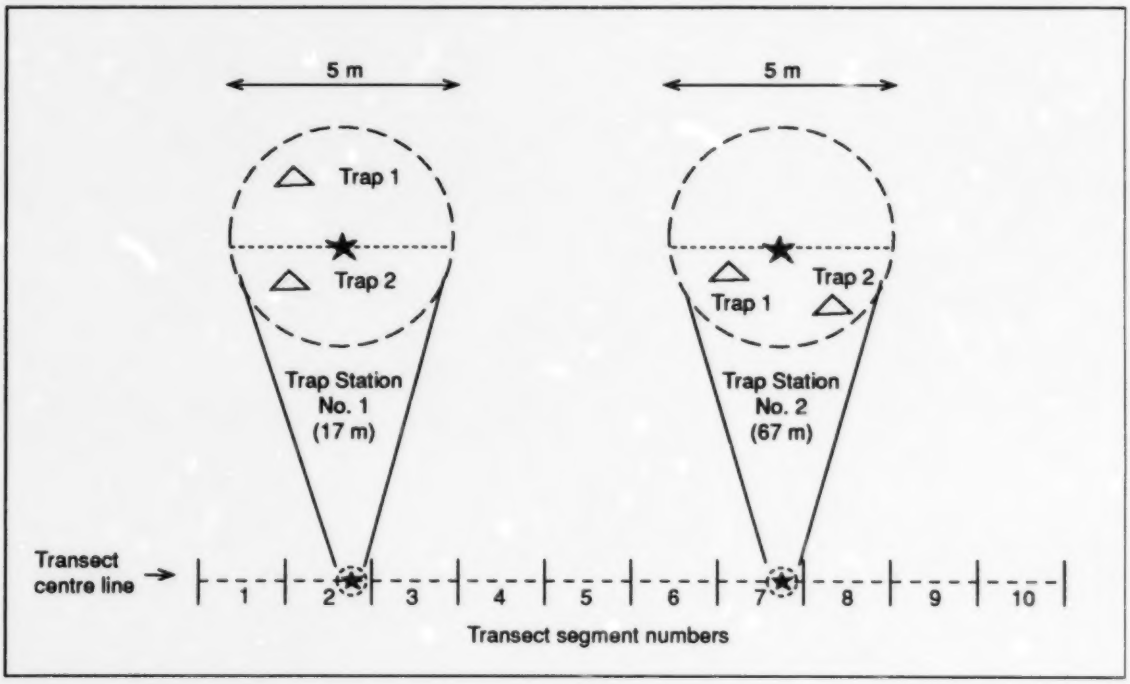


FIGURE 5. Example of layout for part of a small mammal trapline.

Some kind of cover overhead is desirable both to prevent rain from setting off the traps, and to reduce their accessibility to non-target species such as small birds. That cover can be provided artificially, by appropriate arrangement of ground debris. Some minor digging may be required at trap sites, to ensure that traps lie firmly and flat, with sufficient room overhead for the capture wire to complete its full arc when sprung.

Small mammals are mostly nocturnal, and most captures will occur at night. Traps should be checked as early in the morning as practicable, to prevent losses and spoilage of specimens. A few spare traps should be carried during trap checks, to replace those lost or broken overnight. Each trapping session will involve activities on at least 3 days, including 1 for the initial setting of traps and 2 or more for trap checks. The time required to set and check traps amounts to only a few minutes per station, but may nevertheless involve hours of work for very long transects.

2.5.2 Seasonal timing

Small mammal populations fluctuate seasonally, with the lowest numbers occurring in spring before the year's first young are mobile. Thus, there is an inherent scheduling conflict in many habitats, where the best visual transect results are obtained in spring, before green-up (Section 2.3.1). For relatively dry or open habitats (i.e., those in which annual vegetation growth will not significantly affect the visual requirements for transects), it may be possible to conduct the transect later (within the period mid-June through August) and set out the small mammal trapline while the transect is in progress. For other areas, it will be necessary to flag transects identified for small mammal trapping, and then go back to them later for the trapping session.

2.5.3 Handling of specimens

Life history information for many of the small mammals in British Columbia is sparse, particularly on potential variations between locations or habitats. For example, a particular species may occur in some habitats only during dispersal or at high population levels, and with mostly non-reproductive individuals involved. Trapped specimens should be placed in small plastic bags, with appropriate labels, and brought back to the lab (or camp) for processing. Labels should show the project and transect ID numbers (see Section 3.1), the number of the transect segment in which the trap station occurs, and the date. If both traps at a particular trap station are successful in making captures, the two specimens may be placed in one bag with one label applying to both.

In addition to location and date, the minimum data required for each specimen are its species identification, sex, four standard measurements (Fig. 6), and weight (gm). Adult-sized female specimens should be further examined, externally and by dissection, to determine general reproductive status (e.g., pregnant or lactating). When present, placental scars or embryos should be counted (see Kirkpatrick 1980), and embryos should be measured (crown-rump length, Fig. 6). The identification of some small mammals (notably the species of *Microtus* and most shrews) can be difficult, and even sex determination is tricky for shrews. Provision should be made either to preserve and deliver specimens that require such special expertise or to ensure, through appropriate training, that the expertise is present on site. The best preservation method is freezing, although specimens can be kept fresh for a few days in coolers with wet or dry (CO_2) ice. Preserving with chemicals is also possible (Wobeser *et al.* 1980). Figure 7 provides an example of a specimen data form with entries for several captured animals.

2.6 Herpetofauna Search

Some species of amphibians and most reptiles in British Columbia are potentially detectable both by direct contacts and by sign along transects. Other species, particularly certain salamanders, may be abundant in

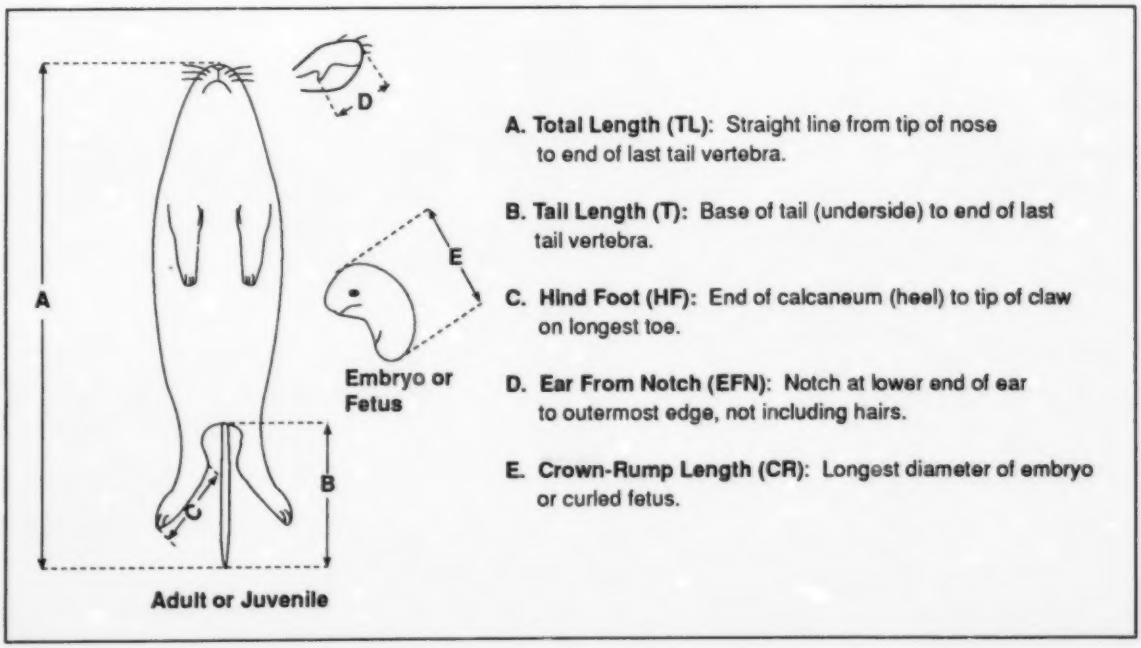


FIGURE 6. Standard measurements of mammal specimens.

SPECIMEN NO.	SPECIES	SEX	MEASUREMENTS TL T HF EFN	WT	EMBRYOS/FETUSES NO.	CR	REMARKS
DLA0001-N-3(1)	PEMA	M	181-84-20-6	20	–	–	Very light tan colour above
" "	" "	F	177-78-19-6	28	–	–	Lactating; 6 placental scars
" "	8(1) CLGA	F	115-31-18-3	16	–	–	Obvious juvenile
" "	13(1) "	F	147-40-19-4	41	5	8	Pregnant
" "	48(1) MIPE	M	157-39-19-5	40	–	–	
" "	3(2) unsh	–	121-54-14-x	6	–	–	Saved; species & sex unknown.
" "	18(2) MIPE	F	154-33-19-5	37	–	–	Repro. activity not evident.
" "	23(2) CLGA	F	142-38-18-4	35	4	4	Pregnant

FIGURE 7. Example of specimen data for several small mammals.

local ecosystems, but will almost never be encountered in the open. As for small mammals, a separate, more intensive survey effort may therefore be required. I now consider that effort as optional, to be conducted if the project co-ordinator judges it desirable. That will most likely be the case in moist forest habitats, particularly along the coast or in the southern interior of the province.

Established sampling methods for herpetofauna are labour intensive. Based on discussions in Corn and Bury (1990), I recommend the use of a modified "time-constrained search," with the following characteristics:

- that it be restricted to the area within a circle of 10 m radius, as defined by the sample rope staked on the transect centre line.
- that it be continued for 30 man-minutes (e.g., for a two-person team this could be accomplished by each searching half the circle for 15 minutes).
- that it involve tearing apart and looking under decaying coarse woody debris (CWD), looking under other moveable objects such as intact CWD and boulders, and raking aside piles of smaller debris such as bark or slash.

Special equipment such as crowbars are required for such searches. For mechanical details and advice on disposition of specimens, consult Corn and Bury (1990). The most practical way to add the herpetofauna search to the general transect survey is to use the stations established for small mammal trapping as the centres for the circular search plots. Specifically, locate the first plot at the first trapping station, and subsequent plots on every other station thereafter, giving 100-m intervals between plots. For a 1-km transect, this would provide for 10 plots requiring 150 minutes (2.5 hours) of searching for a two-person team. The herpetofauna searches should be done on the day small mammal traps are picked up. This approach makes use of the travel time applicable to the trapping, but delays the unavoidably destructive search work until after the trapping is complete.

3 FIELD DATA ENTRY

Four data forms and a list of data codes, combined on four separate pages, are associated with the wildlife transects described here. Forms WM-1A (Project Information) and WM-1B (Transect Information) constitute the first two pages. Most of the items on both of these are completed before a particular transect survey is started. The field data sheet (WM-2A) appears on the front of page 3; the main key to data codes used on the field data forms (WM-2B) is on the back of that sheet. The last page bears a form (WM-3) that provides for entry of supplementary data on incidental observations (i.e., inside the project area, but outside transect boundaries), as well as more expansive notes on particular observations. The following sections provide step-by-step instructions, advice, and examples in relation to each of these forms.

3.1 Project Information Form (WM-1A)

This form (Fig. 8), was designed to be compatible with the "Project Description Form (EM-1)" in the environmental monitoring system (Habitat Monitoring Committee 1990). Form WM-1A is for identifying and describing major features of the overall study program and project area, and in most cases the responsibility for filling it out will fall to a project co-ordinator rather than to the transect survey team. As used here, the term "project" refers to the series (one or more) of wildlife monitoring transects for which the data on the form apply. The following paragraphs provide instructions for filling out the 12 numbered data items on Form WM-1A (both sides). Appendix 1 shows a completed example.

1) Project ID Number: If the wildlife monitoring project (series of transects) is to be performed on an area previously or currently subject to formal environmental monitoring studies (Habitat Monitoring Committee 1990), the project number will be the same as that applied to the environmental monitoring. For other projects (i.e., those that are separate from or preceding environmental monitoring), the first three characters (all alphabetic) of the seven-character code identify the forest region or district where the work is carried out (Table 1). The four remaining characters (all numeric) can be any unique set for that region and district. For example, the Project ID Number DLA0001 might be used to identify the first wildlife monitoring project in the Lakes District of the Prince Rupert Forest Region.

2) Ministry of Environment Region and Management Unit: As depicted in the "British Columbia 1991–92 Hunting and Trapping Regulations Synopsis," there are eight Ministry of Environment administrative regions/sub-regions in the province. They are identified in Table 2, and the number of management units in each is given. The data requirement for this item is a three-character code (all numeric), in which the first character is the region number and the last two the management unit. For the example area given in item 1, the appropriate entry here might be 6-04 (Skeena Region, M.U. 04).

TABLE 1. B.C. Ministry of Forests Regions and Districts (from Habitat Monitoring Committee 1990)

REGION District	REGION District	REGION District	REGION District
VANCOUVER (RVA)	DGO Golden	CARIBOO (RCA)	DDC Dawson Creek
DCK Chilliwack	DRE Revelstoke	DQU Quesnel	DJO Fort St. John
DMC Mid Coast	DAR Arrow	DWL Williams Lake	
DSQ Squamish	DBO Boundary	DHO Horsefly	PRINCE RUPERT (RPR)
DSC Sunshine Coast	DKL Kootenay Lake	DMH 100 Mile House	DLA Lakes
DPM Port MacNeill		DCH Chilcotin	DMO Morice
DDU Duncan	KAMLOOPS (RKA)		DBU Bulkley
DPA Port Alberni	DCL Clearwater	PRINCE GEORGE (RPG)	DKI Kispiox
DCR Campbell River	DKA Kamloops	DPG Prince George	DKM Kalum
DQC Queen Charlotte	DSA Salmon Arm	DFN Fort Nelson	DNC North Coast
	DVE Vernon	DRV Robson Valley	DCA Cassiar
NELSON (RNE)	DPE Penticton	DVA Vanderhoof	
DCB Cranbrook	DME Merritt	DJA Fort St. James	
DIN Invermere	DLI Lillooet	DMK Mackenzie	

WILDLIFE MONITORING FORM (WM-1A)
PROJECT INFORMATION

Project ID Number _ _ _ _ _ _ _

Has MoE/MoF Environmental Monitoring been completed (Yes___ No___)
or is it in progress (Yes___ No___) in the study area?

If yes to either, enter relevant Project ID Number above (from Form EM-1).

If no to both, assign new 7-digit ID number above, and provide location and site description information in the box below (items 2 - 4).

2) MoE Region - Mgmt Unit _ - __. 3) Mapsheet _____

4) Biogeoclimatic Zone and Subzone _____

5) Ecoregion _____ Ecosection _____

6) Project Area:
   a) FRDA Research Study area (Project No. _____), or...
   b) FRDA Operational Reforest. area (Proj. No. _____), or...
   c) Other (Describe)_____

7) Project Coordinator(s) _____

8) Agency _____

9) Objective (select 1 from list below, by letter): ___

Baseline Data for: a) Single habitat unit; b) Several habitats or habitat units (regional); c) Area proposed for development; d) Other (specify) _____

Comparative Data (treatment areas + controls) for: e) forest harvesting methods; f) silviculture research; g) silviculture operations; h) wildfire; i) Prescribed burn; j) wildlife habitat enhancement; k) Other (specify) _____

10) Number of Transects ____

11) Transect ID's _ _ _ _ _ _ _ _ _ _

12) Attach map(s) or airphoto(s), or provide a diagram in the box on the reverse side of this form, identifying or showing:

- The overall project area, labelled with the Project ID Number.
- Scale (map or air photo only).
- All transects, labelled with their ID code letters and showing direction of travel.
- Baseline for selection and orientation of transects, if present.
- Pertinent landmarks as related to the boundaries of the project area, the baseline, and/or the position of one or more of the transects; indicate associated distances from landmarks to project features where appropriate.

The project area and transect locations are shown on (check one or more):
a) Attached map(s):___ Number __ Code(s)_____.

b) Attached airphoto(s):___ Number __ Code(s)_____.

c) Diagram (over):___.

FIGURE 8. The Project Information Form (WM-1A).

TABLE 2. B.C. Ministry of Environment Regions and sub-regions

Region or sub-region	Management units	Region or sub-region	Management units
1 Vancouver Island	15	5 Cariboo	16
2 Lower Mainland	19	6 Skeena	30
3 Thompson – Nicola	30	7 Omineca – Peace	58
4 Kootenay	36	8 Okanagan	21

3) Mapsheet: Record the number of the largest scale mapsheet that encompasses the entire project area. The formats for identifying and listing maps in the National Topographic Series (NTS), B.C. Series, or the B.C. Forest Service system are:

1:10 000 scale (B.C. Series)	104H/057/2
1:20 000 scale (B.C. Series)	92F/057
1:20 000 scale (BCFS, 20 chain)	104H/4/E
1:50 000 scale (NTS or B.C.)	93L/10
1:100 000 scale (NTS)	93L/NW
1:125 000 scale (NTS or B.C.)	82H/NW
1:250 000 scale (NTS or B.C.)	104H

4) Biogeoclimatic Classification: Enter the biogeoclimatic zone and subzone in which the project area occurs, using the alphabetic codes listed in Table 3. The zone designation consists of up to four characters, all upper-case, while the subzone code is one or two lower-case characters. For some projects it may also be desirable to list particular subzone variants. In these instances, another source (e.g., Luttmerding *et al.* 1990, Table 2.4) will need to be consulted for the applicable code.

5) Ecoregion Classification: Enter the ecoregion (alphabetic characters, full name) and ecosection (three-character alphabetic code), as listed in Table 4. See Luttmerding *et al.* (1990) for additional explanations and for a map of the ecoregions of British Columbia.

6) Project Area: If the wildlife monitoring is being undertaken on a previous or current FRDA research or operational area, enter the FRDA project number. For other kinds of study areas, such as those relating to baseline ecological research or developmental impacts, briefly describe the project focus. Following are some fictitious examples:

- Area to be flooded behind the proposed _____ dam.
- Study area for grizzly bear research, MOE, Smithers.
- Area proposed for mine development.

7) Project Co-ordinator(s): Name the person(s) leading the wildlife monitoring activities. Co-ordinators are the people responsible for identifying project areas, selecting transects, supervising data collection, and providing the final analyses and reports. In some cases, co-ordinators may also conduct some or all of the transect surveys. Enter the last name(s) in full; first names may be abbreviated. If more than one person is involved, separate the names with semicolons (e.g., U.R. Nice; I.M. Nicer).

8) Agency: For consistency with Habitat Monitoring Committee (1990), use established codes as listed in Table 5 to identify the agency or organization sponsoring or conducting the wildlife monitoring project. Two agencies can be listed for co-operative projects. In the case of private industry, show the applicable code (I or X, followed by two to three letters from the company name), so that transferring to Environmental Monitoring forms is easier if required, but also write out the company name(s) in full.

TABLE 3. Biogeoclimatic zones and subzones of British Columbia (from Luttmerding *et al.* 1990)

ZONE Subzone		ZONE Subzone		ZONE Subzone	
ALPINE TUNDRA (AT)		INTERIOR CEDAR – HEMLOCK (ICH)		SUB-BOREAL SPRUCE (SBS)	
(No subzones recognized)		ICHxw	Very Dry Warm	SBSdh	Dry Hot
BUNCHGRASS (BG)		ICHdw	Dry Warm	SBSdw	Dry Warm
BGxh	Very Dry Hot	ICHdk	Dry Cool	SBSdk	Dry Cool
BGxw	Very Dry Warm	ICHmw	Moist Warm	SBSmh	Moist Hot
BOREAL WHITE & BLACK SPRUCE (BWBS)		ICHmm	Moist Mild	SBSmw	Moist Warm
BWBSdk	Dry Cool	ICHmk	Moist Cool	SBSmm	Moist Mild
BWBSmw	Moist Warm	ICHmc	Moist Cold	SBSmk	Moist Cool
BWBSwk	Wet Cool	ICHwk	Wet Cool	SBSmc	Moist Cold
COASTAL DOUGLAS-FIR (CDF)		ICHvk	Very Wet Cool	SBSwk	Wet Cool
CDFmm	Moist Maritime	ICHvc	Very Wet Cold	SBSvk	Very Wet Cool
COASTAL WESTERN HEMLOCK (CWH)		INTERIOR DOUGLAS-FIR (IDF)		SPRUCE – WILLOW – BIRCH (SWB)	
CWHxm	Very Dry Maritime	IDFxh	Very Dry Hot	SWBdk	Dry Cool
CWHdm	Dry Maritime	IDFxw	Very Dry Warm	SWBdks	Dry Cool Scrub
CWHds	Dry Submaritime	IDFxm	Very Dry Mild	SWBmk	Moist Cool
CWHmm	Moist Maritime	IDFdm	Dry Mild	SWBmks	Moist Cool Scrub
CWHms	Moist Submaritime	IDFdk	Dry Cool		
CWHwh	Wet Hypermaritime	IDFmw	Moist Warm		
CWHws	Wet Submaritime	IDFww	Wet Warm		
CWHvh	Very Wet Hypermaritime	MOUNTAIN HEMLOCK (MH)			
CWHvm	Very Wet Maritime	MHmm	Moist Maritime		
ENGELMANN SPRUCE – SUBALPINE FIR (ESSF)		MHwh	Wet Hypermaritime		
ESSFxc	Very Dry Cold	MHmmp	Moist Maritime Parkland		
ESSFdk	Dry Cool	MHwhp	Wet Hypermaritime Parkland		
ESSFdc	Dry Cold	MONTANE SPRUCE (MS)			
ESSFdv	Dry Very Cold	MSxk	Very Dry Cool		
ESSFmw	Moist Warm	MSxv	Very Dry Very Cold		
ESSFmm	Moist Mild	MSdm	Dry Mild		
ESSFmk	Moist Cool	MSdk	Dry Cool		
ESSFmc	Moist Cold	MSdc	Dry Cold		
ESSFmv	Moist Very Cold	PONDEROSA PINE (PP)			
ESSFwm	Wet Mild	PPxh	Very Dry Hot		
ESSFwk	Wet Cool	PPdh	Dry Hot		
ESSFwc	Wet Cold	SUB-BOREAL PINE – SPRUCE (SBPS)			
ESSFwv	Wet Very Cold	SBPSxc	Very Dry Cold		
ESSFvc	Very Wet Cold	SBPSdc	Dry Cold		
ESSFvv	Very Wet Very Cold	SBPSmk	Moist Cool		
		SBPSmc	Moist Cold		

9) Objective: Choose, from the list provided, the objective that most closely identifies the primary wildlife monitoring project objective. For example, in the fictitious grizzly bear research project listed in item 6, above, the monitoring objective might be under the category "Other" (item d), and described as "baseline data for wildlife occurrence on avalanche slopes regularly used by bears."

10) Number of Transects: Enter the total number of wildlife monitoring transects to be surveyed in the project area (e.g., 5).

11) Transect ID's: Identify each of the project transects enumerated in item 10 with an alphabetic character in caps (A,B,C . . .), and enter those here. For the example given in item 10 (five transects), the transect ID's are likely to be A, B, C, D, E. However, if a set of transects constitutes only part of a larger study program involving more than one visit to a project area (e.g., in different seasons), it may be desirable to keep

TABLE 4. Ecoregions and ecosections of British Columbia (from Luttmerding *et al.* 1990)

ECOREGION / Ecosection	
ALBERTA PLATEAU	
KIP	Kiskatinaw Plateau
PEL	Peace Lowland
SBU	Sikanni–Beatton Plateau
BULKLEY RANGES	
BUR	(no ecosections)
CHILCOTIN RANGES	
ECR	Eastern Chilcotin Ranges
WCR	Western Chilcotin Ranges
FRASER PLATEAU	
BUB	Bulkley Basin
CAP	Cariboo Plateau
CCB	Chilcotin–Cariboo Basin
CHP	Chilcotin Plateau
NAU	Nazko Upland
NEP	Nechako Plateau
COASTAL GAP	
HEL	Hecate Lowland
KIR	Kitimat Ranges
CONTINENTAL SHELF	
DIE	Dixon Entrance
HED	Hecate Depression
VIS	Vancouver Island Shelf
NASS BASIN	
NAB	(no ecosections)
NASS RANGES	
NAR	(no ecosections)
NORTHERN COAST AND MOUNTAINS	
ALR	Alsek Ranges
BOR	Boundary Ranges
PACIFIC AND CASCADE RANGES	
EPR	Eastern Pacific Ranges
NPR	Northern Pacific Ranges
NWC	Northwestern Cascade Ranges
OUF	Outer Fiordland
SPR	South Pacific Ranges
QUEEN CHARLOTTE LOWLAND	
QCL	(no ecosections)
QUEEN CHARLOTTE RANGES	
SKP	Skidegate Plateau
WQC	Windward Queen Charlotte Mountains
WESTERN VANCOUVER ISLAND	
NIM	Northern Island Mountains
NWL	Nahwitti Lowlands
WIM	Windward Island Mountains
EASTERN VANCOUVER ISLAND	
LIM	Leeward Island Mountains
NAL	Nanaimo Lowland
LOWER MAINLAND	
FRL	Fraser Lowland
GEL	Georgia Lowland
STRAIT OF GEORGIA	
SOG	(no ecosections)
CONTINENTAL RISE	
COR	(no ecosections)
CONTINENTAL SLOPE	
COS	(no ecosections)
ICEFIELD RANGES	
ICR	(no ecosections)
LIARD BASIN	
LIP	Liard Plain
LIU	Liard Upland
NORTHERN MOUNTAINS AND PLATEAUS	
CAR	Cassiar Ranges
KEM	Kechika Mountains
SBP	Southern Boreal Plateau
STP	Stikine Plateau
TEP	Teslin Plateau
TUR	Tuya Range
NORTHERN ROCKY MOUNTAINS	
MUF	Muskwa Foothills
MUR	Muskwa Ranges
TATSHENSHINI BASIN	
TAB	(no ecosections)
YUKON – STIKINE HIGHLANDS	
TAH	Tagish Highland
THH	Tahltan Highland
OKANAGAN RANGES	
OKR	(no ecosections)
THOMPSON – OKANAGAN PLATEAU	
CLR	Clear Range
ETU	Eastern Thompson
NTU	Northern Thompson
OKB	Okanagan Basin
OKH	Okanagan Highland
STU	Southern Thompson
THB	Thompson Basin
COLUMBIA MOUNTAINS AND HIGHLANDS	
CCM	Central Columbia
EPM	Eastern Purcell Mountains
MCR	McGillivary Range
NCM	Northern Columbia Mountains
QUH	Quesnel Highland
SCM	Southern Columbia Mountains
SHH	Shuswap Highland
SOUTHERN ROCKY MOUNTAINS	
BRR	Border Ranges
CCR	Central Continental Ranges
NCR	Northern Continental Ranges
SCR	Southern Continental Ranges
SOUTHERN ROCKY MOUNTAIN TRENCH	
BBT	Big Bend Trench
EKT	East Kootenay Trench
UFT	Upper Fraser Trench
CENTRAL ROCKY MOUNTAINS	
HAF	Hart Foothills
HAR	Hart Ranges
FRASER BASIN	
BAU	Babine Upland
NEL	Nechako Lowland
SKEENA AND OMINECA MOUNTAINS	
ESM	Eastern Skeena Mountains
OMM	Omineca Mountains
WSM	Western Skeena Mountains
FORT NELSON LOWLAND	
FNL	(no ecosections)

TABLE 5. Agency codes, as established by Habitat Monitoring Committee (1990)

C – CANADIAN FEDERAL AGENCIES
- CA – Agriculture Canada
  - CAVA – Vancouver Research Station
  - CAAG – Agassiz Research Station
  - CAKA – Kamloops Research Station
- CE – Environment Canada
  - CELD – Lands Directorate
  - CEFS – Canadian Forestry Service

I – INDUSTRY
- e.g., IFC – Fletcher Challenge Ltd.
  - IMB – MacMillan Bloedel Ltd.

M – PROVINCIAL AGENCIES
- ME – B.C. Ministry of Environment
  - MEW – Wildlife Branch
  - MEF – Fisheries Branch
  - MEIM – Integrated Management Branch
  - MEPM – Pesticide Management Branch
- MF – B.C. Ministry of Forests
  - MFRS – Forest Sciences Section or Research Branch
  - MFRG – Range Section or Integrated Resources Branch
  - MFI – Inventory Branch
  - MFS – Silviculture Branch
  - MFP – Protection Branch
- MA – B.C. Ministry of Agriculture and Fisheries
  - MAS – Soils and Engineering Branch
  - MALC – Agricultural Land Commission
- ML – B.C. Ministry of Crown Lands
  - MLSR – Surveys and Resource Mapping Branch

N – NON-GOVERNMENT AGENCIES
- e.g., NDU – Ducks Unlimited
  - NNT – Nature Trust
  - NNF – Nature Federation

U – UNIVERSITIES
- UBC – University of British Columbia
- USF – Simon Fraser University
- UVIC – University of Victoria

X – CONSULTING COMPANIES
- e.g., XAE – Arctic Ecosystems Ltd.

it and subsequent sets clearly separate by not duplicating Transect ID's. For example, in the above case, a set of five additional transects in a different but related area, or different season in the same area, might be labelled F, G, H, I, J.

12) Map/Photo/Diagram: The purpose here is to provide an overall picture of the project location and area, and transect layout. The scale at which that is done is left to the discretion of the user, but should be identified on the map(s) or photo(s) used. Diagrams do not necessarily have to be drawn to scale, but important distances should be indicated. Items a–c on the form should be filled out to indicate the nature and quantity of graphic material accompanying the completed form. In some cases, it may be desirable to use all three types, working from a relatively small scale map to a larger scale photo, and finally to the diagram. Entries under "number" in relation to maps and photos indicate the number of separate sheets/photos used; "codes" refer to official map designations as described under item 3, above, and air photo flight line and exposure numbers. Figure 9 shows an example of a completed project diagram.

3.2 Transect Information Form (WM-1B)

This form (Fig. 10) is to document the personnel, timing, conditions, and specific habitat features associated with each individual transect. Instructions for filling out the eight data items on Form WM-1B are provided below, and an example of a completed form is given in Appendix 2.

First, enter the Transect ID code (single alphabetic character [e.g., A]) and Project ID Number at the top of the page.

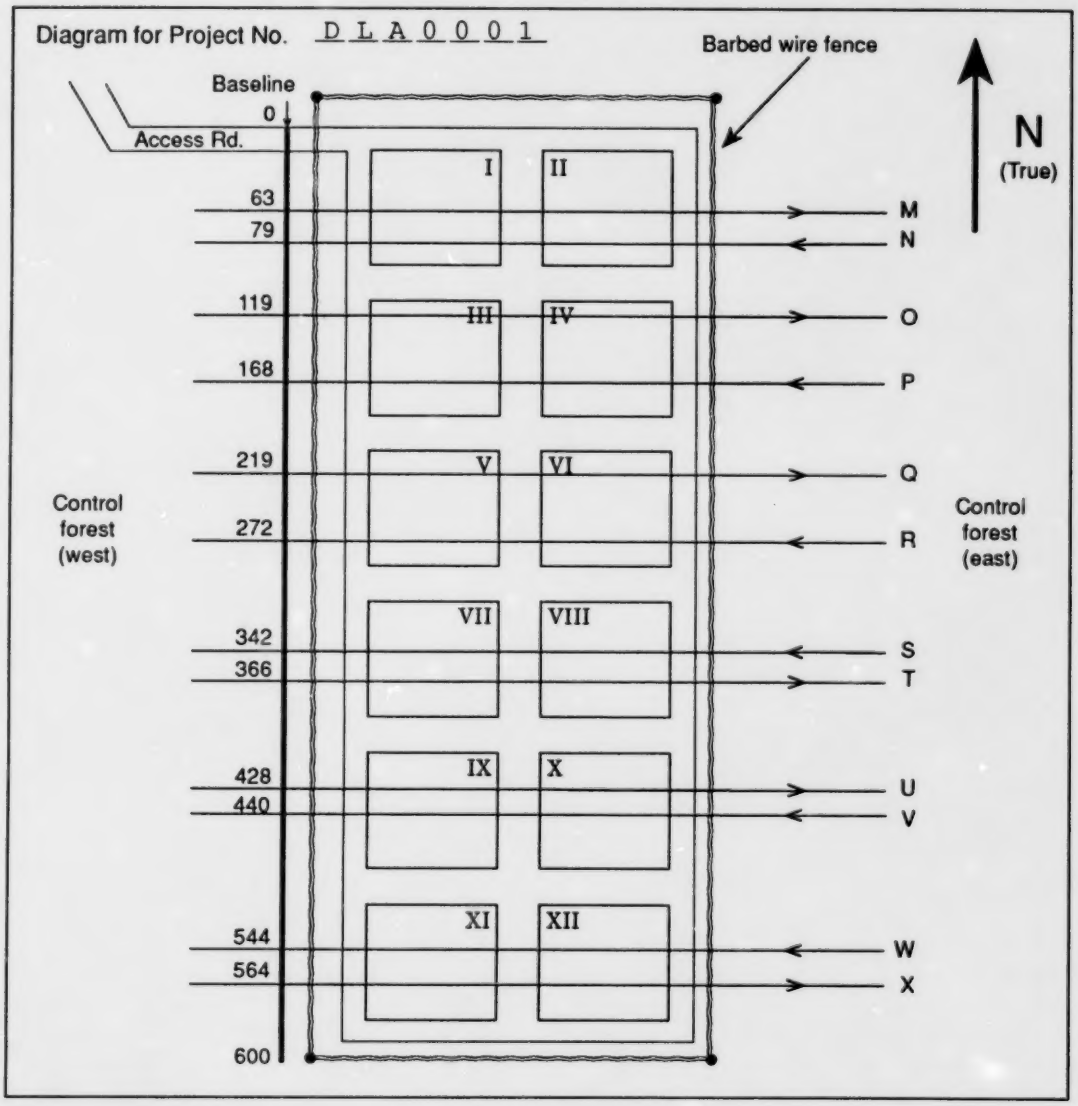
13) Observer(s): Enter the name(s) of the person(s) collecting data along the transect. Enter the last name(s) in full, but first names may be abbreviated. If more than one person is involved, separate the names with semicolons as in item 7 of form WM-1A.

14) Survey Date: Enter the date on which the field survey is completed, as two-character numeric fields for year (YY), month (MM), and day (DD) (e.g., 12 November 1990 = 90, 11, 12).

15) Survey Times: Enter times at the start and end of the transect, using the 24-hour clock (e.g., a transect conducted between 9:15 a.m. and 2:10 p.m. would be shown as: Start 09:15, End 14:10).

16) Weather Conditions: Briefly summarize the weather prevailing during the transect, with particular reference to conditions that might affect the results, such as per cent cloud cover, incidence of precipitation,

PROJECT INFORMATION (CONTINUED)



Comments: The Roman numerals identify 12 silviculture research plots. The 12 transects (M - X) were selected randomly off the baseline (numbers shown), selecting the first 2 that fall within each "horizontal" (east-west) pair of plots. The transects extended into the control forest on both sides of the treatment opening with those portions commencing at the fenceline. Portions within the treatment area were from and to the inside edges of the surrounding road, but including the dividing trail down the middle. Direction of travel for each transect is shown on the right.

FIGURE 9. Example of a completed project diagram.

WILDLIFE MONITORING FORM (WM-1B)
TRANSECT INFORMATION

TRANSECT ___ PROJECT ID NO. _ _ _ _ _ _ _

13) Observer(s): _____

14) Survey Date: ___, ___, ___ (YY MM DD) 15) Survey Times: Start _____ End _____

16) Weather Conditions _____

17) Ground snow covered? Yes__, No__. If yes, per cent coverage ____%, average depth (cm) _____, and number of days since last snowfall _____.

18) Small Mammal Trapline? Yes__, No__. If yes, first station location ____.

19) Herpetofauna Search? Yes__, No__. If yes, first station location ____.

20) Habitat Unit or habitats sampled: If transect is restricted to a single habitat unit from a previous or current environmental monitoring project, enter the Sample No. from Form EM-2 _____. Otherwise, select habitats from the list below, and enter in order from start to end of transect: __ , __ , __ , __ , __ , __ , __ , __ , __ .

Mature Conifer Forest:	Deciduous Forest:	l) riparian shrub; m) wetland;
a) pine dominated	f) aspen dominated	n) herb/forb meadow
b) spruce dominated	g) cottonwood dominated	o) regenerating burn (wildfire)
c) balsam dominated	h) birch dominated	p) regenerating cutblock
d) other (specify _____)	i) other (specify _____)	r) research/enhancement plot
e) mixed (specify _____)	j) mixed (specify _____)	s) other (specify): _____
k) conifer/deciduous mix (specify _____)		_____

21) Site History for disturbed or manipulated habitat unit or habitats (o,p,r, s, above) crossed by this transect; for habitats in the same category but with different histories, use subscripts, e.g. p_1, p_2, p_3...

Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____

22) Attach map(s) or airphoto(s), or provide a diagram in the box on the reverse side of this form, identifying or showing:

a) Approximate scale.
b) The transect, showing start (SS) and end (EE) points.
c) Transect bearings (based either on magnetic or true north, but indicate which).
d) One or more pertinent landmarks as related to the position of the transect; indicate associated distances where appropriate.
e) Habitat Unit/Habitats, labelled as in items 19 and 20, above.

The transect location and orientation are shown on (check one or more):
a) Attached map: ___ Number __ Code _____.

b) Attached airphoto: ___ Number __ Code_____.

c) Diagram (over): ___.

FIGURE 10. The Transect Information Form (WM-1B).

presence of fog, temperature, and wind. Qualitative descriptions — for example "cold, warm, hot" in relation to temperature; "light, moderate, strong" in relation to wind; and "light, heavy" in relation to precipitation — are adequate in the absence of more specific data.

17) Snow Cover: Indicate whether snow is present along the transect and, if so: a) estimate the percentage of the total transect (which is x metres long and 2 m wide) that is covered by sufficient snow to register an animal track; b) provide an estimate of average depth along the transect based on measurements at the start and end; and c) note the number of days since the last measurable snowfall. The nearest weather office may need to be consulted for item c.

18) Small Mammal Trapline: Indicate whether the transect included a small mammal trapline and, if so, the location along the transect line (in m) of the first trap station (see Section 2.5.1).

19) Herpetofauna Search: Indicate whether the transect included a separate search component for amphibians and reptiles and, if so, the location along the transect line (in m) of the first search plot (See Section 2.6).

20) Habitats/Habitat Units Sampled: If the transect is being conducted in conjunction with or following formal environmental monitoring, and is restricted to a "Habitat Unit" as defined for that program (Habitat Monitoring Committee 1990), enter the sample number from their form EM-2. If the wildlife monitoring project is not being carried out in conjunction with environmental monitoring, identify the broad habitat(s) crossed by the transect from the list provided.

21) Site History: Some habitats differ from those adjacent as a result of human impacts and management manipulations or of natural disturbances such as wildfire and avalanche. For those portions of the transect crossing such habitats, the nature and timing of causes are of interest and should be entered here. The form for data entry is a two-character alphabetic code for the management or disturbance, followed by the year that it occurred. Different events or treatments within the same habitat are separated by semicolons. The codes are given in Table 6; see Habitat Monitoring Committee (1990) for definitions and descriptions of most of the management techniques listed.

Following are some fictitious examples of site histories. Note that some of the code–date entries may also be accompanied by comments that provide more explicit information.

- Two regenerating cutblocks found along the same transect:

  Habitat p_1 History – CC 1984; PB 1985; PL 1986; HB 1990 (glyphosate, 2.14 kg/ha).

  Habitat p_2 History – CC 1975; PB 1977; JS 1989.

- Two sections of a recent natural burn, the first untreated and the second with some management applied:

  Habitat o_1 History – WF 1967.

  Habitat o_2 History – WF 1967; KN 1977; PL 1978; JS 1987.

- A wildlife habitat enhancement plot:

  Habitat r History – PB 1985 (moose habitat enhancement).

22) Map/Photo/Diagram: The primary purpose is to provide a more specific picture of the transect layout in relation to the particular habitat unit or habitats being studied. The scale at which that is done is left to the discretion of the user, but should be identified on the map(s) or photo(s) used. Diagrams do not necessarily have to be drawn to scale, but important distances and compass bearings should be indicated. Items a–c on the form should be filled out to indicate the nature and quantity of graphic material accompanying the completed form. As with the project diagram (item 12), it may be desirable to use all three types, working from a relatively small scale map to a larger scale photo, and finally to the diagram. However, in all cases the scale will be larger than for the project diagram. Entries under "number" in relation to maps and photos indicate the number of separate sheets and photos used; "codes" refer to official map designations as described under item 3, above, and air photo flight line and exposure numbers. Figure 11 shows an example of a completed transect diagram.

TABLE 6. Data codes for site histories

FIRE:	SITE PREPARATION:	SITE REHABILITATION:
Wildfire – WF	Scarification – SC	Salvage logging – SA
Prescribed burn – PB	Tillage – TL	Mechanical knockdown – KN
FLOOD:	Fertilization – FE	Bunching/windrowing – BW
Natural flooding – NF	Seeding – SD	
Water level manipulation – WM	Planting – PL	
FOREST HARVESTING:	STAND MANAGEMENT:	
Clearcut – CC	Livestock grazing – GR	
Seed tree – ST	Herbicide application – HB	
Shelterwood – SW	Slashing – SL	
Selection – SE	Juvenile spacing – JS	
Coppice – CP	Thinning – TH	
	Improvement cutting – IC	

3.3 Data Sheet Form (WM-2A)

The data form (Fig. 12) is the primary vehicle for recording observations during the transect surveys. The number of data sheets required will vary, depending on the length of the transect and the variety of wildlife sign that is located, so an ample supply should be at hand. It is important to complete the top box on each sheet used, by entering the Transect and Project ID's precisely as listed on associated forms WM-1A and 1B. The page number entry refers to data sheets only. Thus, for a transect requiring 8 sheets, the first is "Page 1 of 8" and the last is "Page 8 of 8."

Field data are entered in seven columns (identified by Roman numerals at the top of the form). Specific instructions, suggestions, and examples relating to data entries in each of those columns are given below. Items V (Number), VI (Habitat Unit), and VII (Remarks) are described out of sequence, since they are common to all the kinds of wildlife sign discussed and are featured in most of the examples provided.

3.3.1 Segment Number (I)

This refers to the 10-m sample units (segments) defined by the rope technique in a two-person survey. The segments are numbered serially (1 . . . n) from the beginning of the transect to the end. Thus, for a transect that is 1 km long, there will be one *or more* entries for a total of 100 segments. The greater the variety of wildlife sign documented in a particular segment, the more times its number will be listed. For incidental observations (see Section 3.3.6, below), the entry under segment number is an "X" with a subscript. Thus, the sequence of entries "1, 2, 3, X_1, 4, 5, X_2, 6" refers, respectively, to the first three segments, incidental observation No. 1, segments 4 and 5, incidental observation No. 2, and then segment 6.

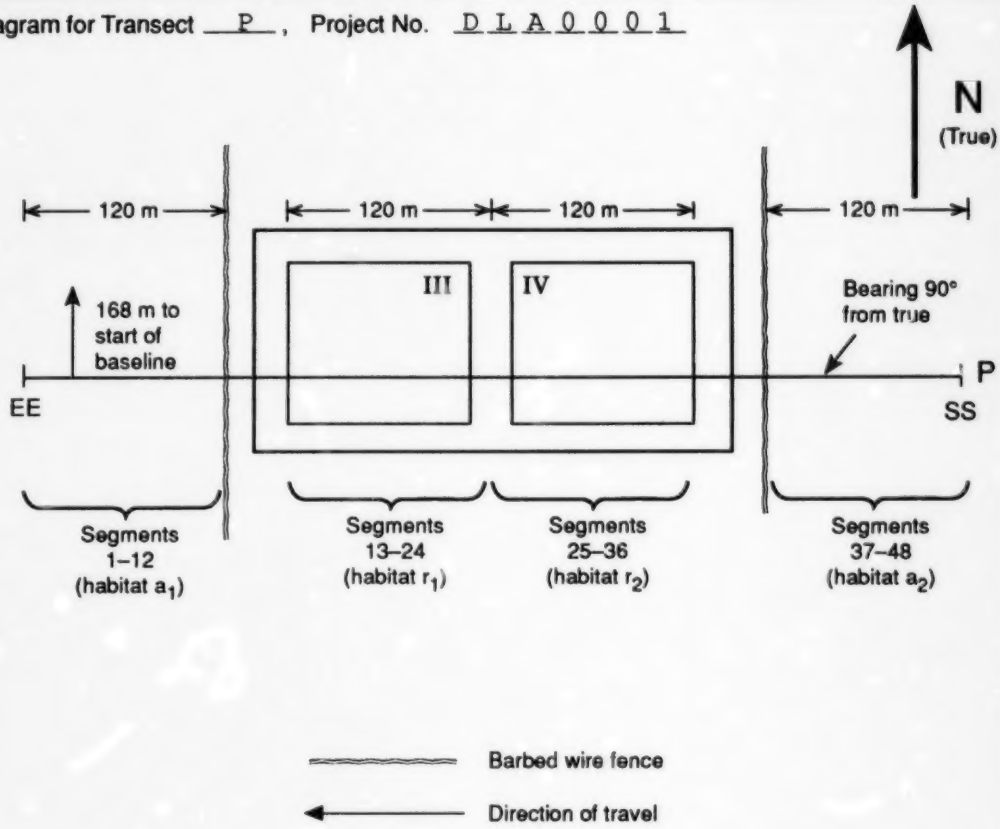
3.3.2 Number (V)

For each line segment, one to three digits should be entered as described below. Each data entry constitutes one record, i.e., contact with one item or individual or a group of like items at a particular location. For example, an observation of one Hairy Woodpecker and three Boreal Chickadees in the same tree would constitute two records, one for each species. A single hare pellet at one location, and a concentration of 100 a few metres farther along the line would also be listed as two records.

- _ _ 0 : This entry is for Sign Class NN (no sign detected) only.
- _ _ 1 : This entry is for the first record of a particular species, sign class, and type of sign in the segment involved.
- _ 1 1 : This entry, made by simply adding another "1" to the left of the first, is for the second observation of that type in that segment, but at a different location within the segment.
- 1 1 1 : This entry, made by adding another "1" to the left of the first two, is for the third observation of that type, and is the last for that segment even if more are found (i.e., it represents "3 or more" records).

PROJECT INFORMATION (CONTINUED)

Diagram for Transect P, Project No. DLA0001



Comments: Note: Because this is a "back-tracking" transect, i.e., one with direction of travel to west and back to baseline, segments are listed in reverse (48-1) on the data form.

FIGURE 11. Example of a completed transect diagram.

WILDLIFE MONITORING FORM (WM-2A)

DATA SHEET

TRANSECT ___ PROJECT ID NO. _ _ _ _ _ _ _ PAGE __ OF __

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUM-BER	(VI) HABI-TAT UNIT	(VII) REMARKS
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
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__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____
__	_ _ _ _	_ _	_ _ - _	_ _ _	__	_____

FIGURE 12. The Data Sheet Form (WM-2A).

Unfortunately, enumeration of sign is not always as "easy as 1-2-3," and judgement is often required. For example, a bird that keeps moving ahead of the survey team should not be counted repeatedly. Likewise, if a scattering of deer pellets along two segments was clearly deposited by one animal while it was moving, that should constitute a record for just one of the segments, not both. If there is uncertainty on that point, then two records would apply. Tracks of a cow and calf moose in one segment would constitute just one record, but with a notation under remarks that two animals were involved. Thus, for segments in which a particular kind of sign is present, the survey team must judge whether there are one, or two, or three or more separate occurrences.

3.3.3 Habitat Unit (VI)

The habitat unit or habitat code should be entered as given in item 20 of form WM-1B. In most cases, a ditto mark or vertical line will apply, indicating that the present habitat or habitat unit is the same as that in the previous segment. The important point is to identify the segments where new habitats or habitat units begin.

3.3.4 Remarks (VII)

This column is for additional description of unidentified sign; identification of a known species listed under a "general" species code; elaboration on habitats, locations, or quantity of sign; or reference to more expansive notes that are provided in Form WM-3.

3.3.5 Species (II)

Not every occurrence of wildlife sign is easily identifiable to species. For example, distinguishing a black bear scat from that of a grizzly bear may be difficult in the absence of other clues such as tracks. Furthermore, some observers are more proficient or experienced than others, or may be specialists for one class of vertebrates. Thus, the data system for these transects is designed to enable some kind of entry, ranging from very general to species-specific, for each observation. Observers are encouraged to take identifications as far as possible without simply guessing, bearing in mind that a correct general designation is better than an incorrect specific one. In some cases, notes in the "remarks" column or on the Incidental Observations Form (WM-3) may provide for a more specific entry later (see below).

Data entry in the species column is in the form of a four-character alphabetic code. For positively identified species, that code is the "official" one designated by Cannings and Harcombe (1990), and is listed in capital letters. For non-specific identifications (e.g., "unidentified weasel" or "sparrow, general"), a four-letter code (all lower-case) has been devised separately here. Form WM-2B (Fig. 13), on the reverse side of the data form, provides codes for 77 vertebrate species or species groups, including 44 mammals, 28 birds, and 5 "herptiles" (reptiles and amphibians). That list is somewhat biased in content to animals associated with forest habitats in the northern half of British Columbia, but it has potential applicability province-wide for most of the major species and species groups. For any particular project area, the co-ordinator may wish to highlight the most common local species. Common names of species not listed on the data codes form may be found on the additional list in Appendix 3.

Entering data in the species column may vary by certainty of identification. For easily identifiable sign such as moose fecal pellets, one is likely to enter the appropriate species code (ALAL) with no hesitation. Another observation, such as a bear scat, may require some further investigation. Upon finding black bear tracks clearly associated with the scat, one could make a species designation (URAM) that is no less certain than that for the moose. In some cases, one may obtain a certain identification (e.g., Spotted Sandpiper) for which there is no listing on the data codes form (WM-2B). In that case, either of two procedures may be followed:

1. Look up the appropriate species code (in this case, SPSA) in Appendix 3.

WILDLIFE MONITORING FORM (WM-2B)
DATA CODES

Codes below are only for items II, III, and IV on the data sheet (WM-2A). For specific instructions relating to data categories I and V - VII, refer to the field manual.

II) Species - Enter 4-letter code, all caps for known species and lower case for general (gen.) or unidentified designation; see field manual under "General Designations" for use of "unma", "unbd", "unam", "unrp" and "unvv"; for known species not listed here, see Appendix 3 in the field manual.

UNGULATES (HOOFED MAMMALS)		marten	MAAM	red-backed vole	rbvo	crow (gen.)	crow
unident. ungulate	unun	fisher	MAPE	field vole (gen.)	micr	Common Raven	CORA
deer (gen.)	deer	wolverine	GUGU	brown lemming	LESI	chickadee (gen.)	cdee
elk	CEEL	mink	MUVI	unident. "mouse"	unro	nuthatch (gen.)	nuha
moose	ALAL	ermine	MUER	OTHER SMALL MAMMALS		bluebird (gen.)	blue
caribou	RATA	unident. weasel	unwe	shrew (gen.)	unsh	thrush (gen.)	thsh
mountain goat	ORAM	river otter	LOCA	bat (gen.)	unbt	American Robin	AMRO
CARNIVORES (MEAT EATERS)		striped skunk	MEME	COMMON FOREST BIRDS		European Starling	EUST
unident. carnivore	unca	HARES AND RABBITS		grouse (gen.)	grou	vireo/warbler (gen.)	viwa
unident. bear	bear	snowshoe hare	LEAM	Spruce Grouse	SPGR	sparrow (gen.)	spar
black bear	URAM	unident. hare fam.	unhf	Blue Grouse	BLGR	junco (gen.)	jnco
grizzly bear	URAR	RODENTS		Ruffed Grouse	RUGR	Red-winged Blkbird	RWBL
gray wolf	CALU	beaver	CACA	ptarmigan (gen.)	ptar	unident. blkbird	blkb
coyote	CALA	porcupine	ERDO	hawk, owl (gen.)	rapt	finch (gen.)	fnch
red fox	VUVU	woodchuck	MAMO	eagle, hawk (gen.)	hawk	passerine (gen.)	pass
unident. dog fam.	undf	grd. squirrel, all-	gdsq	owl (gen.)	owlg	AMPHIBIANS AND REPTILES	
lynx	LYCA	tree squirrel, all-	trsq	sandpiper (gen.)	sdpp	toad (gen.)	toad
bobcat	LYRU	chipmunk (gen.)	cpmk	hummingbird (gen.)	humm	frog (gen.)	frog
cougar	FECO	muskrat	ONZI	woodpecker (gen.)	wdpk	salamander (gen.)	sala
unident. cat fam.	uncf	woodrat (packrat)	NECI	swallow (gen.)	swal	tadpoles (gen.)	tdpl
raccoon	PRLO	deermouse	PEMA	Gray Jay	GRJA	snake (gen.)	snak

III, IV) Sign Class and Type - The broad category of wildlife "sign" is entered as a 2-letter code (caps) under "sign class"; most classes include 2 or more types (2-letters, caps), and some types are further elaborated as sub-types by a 1-digit number (after the hyphen under "sign type"); the classes and types of sign listed here are described and discussed in detail in the field manual.

DIRECT CONTACTS: DC
Types - Sight (SE); Hear (HR).
Sub-T - # detected: 1=1; 2=2,3; 3=4-10; 4=11+.

FECES (SCATS, PELLETS): SC
Types - Pellet (PT); "Pie" (PE); "Cord" (CD); "Blob" (BL).
Sub-T - For CD types only, size (diameter, mm) classes: 1=1-5; 2=6-15; 3=16-25; 4=26+.

BROWSING: BR
Types - Shrub eaten: Alder (AL); Balsam (BA); Birch (BB); Cottonwd (CW); Mtn. Ash (MA); Pine (PN); Red Osier Dogwd (DW); Saskatoon (SS); Willow (WI); Other (OT)--specify in remarks.
Sub-T - Extent: 1=Light (1-15%); 2=Med. (16-65%); 3=Hvy (66+%).

OTHER FEEDING SIGN: FS
Types - Barking (BK); Cutting (CU); Digging (DG); Grazing (GZ); Pawing (PW); Squirrel Feeding Platform (FP) or Midden (MD); Log Ripping (LR); Storing (ST); Pecking (PK); Boring (BO).

BODY PARTS/REMAINS: BP
Types - Shed Antlers (AN), and skin structures (EP); Kill Sites with Skeletal Parts (KS), or only hair/feathers/scales (KE).

TRACKS AND TRAILS: TT
Types - Track(s) in soil (TX); in snow (SN)--to left (SL), to rt (SR). Trails, not incl. voles (TL).
Sub-T - Trail only, width, cm: 1=5-19; 2=20-50; 3=50+.

INCIDENTAL SIGHTINGS: IN

HOME STRUCTURES: HM
Types - Burrows/Dens in Soil (BU); Lodge or Push-up (LD); Nest (NS); Vole Runways/Tunnels (VR).
Sub-T - For BU only, width (cm): 1=1-5; 2=6-12; 3=13-25; 4=26+.

MISCELLANEOUS STRUCTURES: MS
Types - Antler-rub Tree (AT); Bed Site, Large Mammal (BD); Beaver Dam (DM) or canal (CN); Bird Dust Bath Site (DU); Other, Not Listed Here (NL)--specify in remarks.

SMALL MAMMAL TRAPPING DATA: TR
Types - Unsnapped (US); Snapped but Empty (EM); Trap Missing (MS); Animal Captured (CP).
Sub-T - 1,2,3,4 = Trap 1 on days 1-4; 5,6,7,8 = Trap 2 on days 1-4.

NO WILDLIFE SIGN DETECTED: NN

FIGURE 13. The Data Codes Form (WM-2B).

2. Enter the code for the closest general category (for this example, "sandpiper" = sdpp), and write the species name (Spotted Sandpiper) in the remarks column. The latter procedure may be preferable during the transect, since it can be edited in reference to Appendix 3 at a later rest stop or in camp.

General designations: The five most general categories are not specifically listed on the codes form, because they should be used only as a last resort. Thus, a patch of hair may be referable in the field only to the category "unidentified mammal" (unma), and a single feather to "unidentified bird" (unbd). The comparable codes for the other two classes of land vertebrates, amphibians and reptiles, are "unam" and "unrp", respectively. The most general case of all is one in which the observer team has located sign suspected to have been made by a vertebrate (unvv), but has no basis for assigning even one of the above class designations. An example would be indistinct small tracks found in mud beside a pond.

For those very general categories, and for the more generic categories of uncertain identification (e.g., "unident. weasel" or "frog (gen)"), it may be possible to provide descriptive information, or a sample, that will yield a more certain identification later. Both the remarks column and the last data form (WM-3) are designed, in part, for that purpose. For example, a track in the mud may be recognizable only as having been made by a member of the dog family. In that case, the code "undf" (unidentified member of the dog family) could be entered in the species column and "track 4.2 mm wide x 5.3 mm long" in the remarks column. In another case, a well observed woodpecker might be recorded in the generic category (wdpk), but a description that is too long to fit under remarks (e.g., "about robin-sized, mostly black, but with a white patch on the back and yellow on the head") would be entered on Form WM-3. In that case, an entry under remarks is also required (e.g., "see WM-3:4"), which would indicate that notes on that entry have been recorded under Observation No. 4 on Form WM-3. Collected samples (e.g., scats) should also be referenced both under remarks and in WM-3 (see below), and accompanied by a label showing the Project, Transect, and Observation numbers.

Figure 14 shows species entries for the examples given above — the moose and bear, both in segment 1, then the sandpiper, canid track, woodpecker, and unidentified scat in the subsequent four segments.

FORM WM-2A (DATA SHEET)

(I) SEGMENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
1	A L A L		-			
1	U R A M		-			
2	s d p p		-			Spotted Sandpiper
3	u n d f		-			Track 4.2 x 5.3 cm
4	w d p k		-			See WM - 3:4
5	u n u n		-			Collected : WM - 3:5

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
4	About robin size, black w/white patch on back & yellow on head.
5	Unident. ungulate (?) pellets; specimen No. DLA0001-A-5.

FIGURE 14. Examples of species entries on Forms WM-2A and WM-3.

3.3.6 Sign Class (III) and Sign Type (IV)

The broad category of wildlife "sign" should be entered on the data form under "Sign Class," as a two-character alphabetic code (caps). A total of 11 sign classes have been identified and are listed on the data codes sheet (WM-2B). Nine of those classes include two or more "Types" (two-character alphabetic code, caps), and some types are further elaborated as "Sub-types" by a one-digit number after the hyphen in the "Sign Type" column. All are described and discussed below, but the two classes without types are special cases and will be dealt with first. The others are listed in the order given on Form WM-2B.

Incidental Observations (IN): The primary aim under incidental observations is to document occurrences of locally uncommon species that may exist in the project area but which, by chance, rarely or never appear in the narrow confines of the transects. Those occurrences may involve observations made during a transect but beyond its boundaries, or during travel to or between transects. In all cases, the segment number (Column I) takes the form of X with a subscript, as described above (Section 3.3.1). Columns II–VI are filled out as for other observations, and additional descriptive details of the sighting, including location relative to one or more transect lines, are entered on Form WM-3, identified under "Obs. No." by the appropriate X number. Figure 15 provides an example, showing data entries as they would appear on both forms: no observations of wildlife or sign are shown in three consecutive segments (6–8), but a coyote scat is found 1.5 m from the centre line beside segment 8.

Whether or not to include an incidental observation is a judgement call, based on the observer's accumulating experience. If a species has not previously been identified in a project area, despite considerable sampling effort, it is best to include it. Because carnivorous species are generally rare in comparison with species at lower trophic levels, most positively identified sign relating to that general group (carnivores among mammals, raptors among birds) will likely be worth recording.

No Wildlife Sign Detected (NN): Failure to locate wildlife sign in a particular segment is not necessarily a cause for concern or an indication of observer incompetence. In fact, the small segment size was selected to ensure that some zero data would appear, since the distribution of animals is best described by both presence and absence information. The important point is that each segment of the transect must show at least one entry on Form WM-2A. If no sign is detected, that entry will consist of

FORM WM-2A (DATA SHEET)

(I) SEGMENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
6		N N	-	0		
7		N N	-	0		
X_1	C A L A	I N	-	1		Scat : see WM-3 : X_1
8		N N	-	0		
			-			
			-			

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
X_1	Coyote scat found 1.5 m beyond transect boundary adjacent to segment 8.

FIGURE 15. Examples of data entries for incidental observations and for segments with no observations.

the segment number in Column I, the letters "NN" under Sign Class (Column III), and 0 (zero) under "Number" (Column V). Examples of entries for three segments with no observations are shown in Figure 15, above.

Direct Contacts (DC): This category of records differs from those following in that it involves the animals themselves rather than sign they have left behind. In most cases the contact will be by sight or sound, and these are the two choices under the "sign type" column in Form WM-2A. Some species may be detectable and identifiable by a characteristic odour (e.g., skunk). However, determining the source of odours relative to the transect line will rarely be possible, and they are therefore best recorded on the incidentals form (WM-3).

As noted previously, the functional transect width for direct contacts is 10 m either side of the transect centre line, rather than 1 m. Assessment of distance is usually easier for visual contacts than for those by ear, and I therefore recommend that some attempt be made to observe animals that are first detected by sound. That should not take an undue amount of time, since the objective is only to confirm whether they are within 10 m of the transect. "New" species heard from the transect, but beyond the 10-m boundaries, should be listed as incidental observations.

Although mammals produce sounds (e.g., chattering by squirrels, bugling by elk, howling by coyotes and wolves, crashing noises by a fleeing moose in thick timber, and scurrying noises of small mammals through ground vegetation), most contacts by ear will likely involve the songs, calls, and various display sounds (drumming, winnowing) of birds. Frogs and toads may also be fairly vocal at some locations, at the right time of day and season.

The ability to identify bird species by ear varies considerably among observers, and depends on each individual's personal interest, experience, and hearing characteristics. As with other kinds of observations along transects, each observer is encouraged to take identifications as far as possible without guessing. For most observers, "direct contact" records of birds, by sound, will usually be identified in the general categories, such as "chickadee (gen.)", or "passerine (gen.)."

There may be uncertainty, in some cases, about whether birds in flight are in or out of the transect. The key point is whether they are using the habitat through which the transect passes. Thus, a wedge of geese passing high overhead has no relationship to the habitat in question, and is out — even as an incidental observation. Any bird that lands or takes off in the transect habitat, or is obviously hunting there (e.g., a passing swallow or a soaring hawk), is in.

Within the general category of direct contacts, the two "types" listed on the data form are sight (SE) and hear (HR), and those types may be further distinguished by "sub-types" referring to the number of individuals detected. The important point here is that a group of two or more animals of the same species seen (heard) together constitutes one record. Figure 16 shows fictitious data entries for direct contact observations involving segments 9 (one red squirrel heard), 10 (group of seven Ruffed Grouse — a hen

FORM WM-2A (DATA SHEET)

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
9	T A H U	D C	H R - 1	1	b	
10	R U G R	D C	S E - 3	1	"	Hen w/6 downy chicks.
11	n u h a	D C	S E - 1	1	"	Red-breasted...
11	B C C H	D C	S E - 1	1	"	Same tree w/nuthatch
12	w d p K	D C	H R - 1	1	"	Hammering... not seen

FIGURE 16. Examples of data entries for direct contact observations.

with six chicks — seen), 11 (a Red-breasted Nuthatch and a Black-capped Chickadee seen in the same tree), and 12 (an unidentified woodpecker heard hammering on a tree overhead along the transect line), all in a spruce stand (Habitat "b" on Form WM-1B).

For the data in Figure 16, it is assumed that the recorder knew the correct species codes for the squirrel and chickadee, and entered them accordingly, but elected to use the general category code for nuthatch, identifying the species in the remarks column for later updating. Note that under the "Number" column (VI), the only designation for these observations is "_ _ 1". This indicates that there was only one observation of each kind, regardless of the number of individuals involved. Thus, "_ 1 1" after the grouse observation would indicate that two hens, each with six chicks, were seen in that segment. Note, too, that the chickadee and nuthatch get separate listings for segment 11, even though they were together, because they are different species.

Note: The special case of direct contact observations resulting from herpetofauna searches (Section 2.6) is not shown on the data codes form. If such structured searches for amphibians and reptiles are undertaken, any animals found or seen in the search plot should be listed under the sign class "HS" rather than "DC"; the sign type and sub-type categories are the same as those under "DC."

Feces (SC): Of the true "sign" remaining after the animal has left, fecal remains are among the most commonly encountered. Four main types, based on form, are recognized here:

- pellets – small (rarely longer than 3 cm), usually ovoid to cylindrical, with size and shape fairly regular for and characteristic to species (mostly herbivores); may be deposited singly or in groups.
- cords – elongate droppings, usually roughly circular in cross-section, and constricted or pointed at the ends; often coiled and sometimes irregularly segmented; characteristic of carnivores.
- pies – large deposits of homogenous material that tend to spread out in a disk-like form, as exemplified by the output of domestic cattle; result from an animal's feeding on soft (as opposed to woody) vegetation, including berries.
- blobs – similar to the pie form in being the result of feeding on soft materials, but smaller and with no discernable or consistent shape; most typically produced by birds, and often all or partly white.

Intergrades of these types may occasionally be found. For example, a moose or deer may produce a conglomerate dropping, between pellets and pie in form, when it is consuming both woody browse and soft vegetation, or when it is in transition between these two diets. The observer must judge which designation most closely applies and note the intergrade nature under "Remarks."

A special case of pellet-form food waste warrants mention here. Many raptors produce, by regurgitation, a roughly cylindrical casting that may resemble a carnivore "cord," but is more compact and usually just slightly rounded at the ends. Different from the sawdust-like contents of most fecal pellets, owl and hawk pellets usually contain hair or feathers, and bone. Other birds, such as grouse, may also regurgitate undigested materials such as berry seeds and skins, although usually in a form more like blobs than like pellets. While not truly feces, regurgitated castings serve a similar function and should be listed under that class of sign. Whether raptor pellets are classified as "pellet" or "cord" will depend on their appearance to the observer. The type classification for feces has no significance other than as an aid to identification of the animals involved.

Another consideration of animal sign, particularly feces, is its relative age. The persistence of fecal remains depends on a number of factors, including contents and local climate conditions. For comparisons involving manipulated habitats, results could be biased if some of the sign that is present along the transect pre-dates the manipulation. Ideally, the wildlife records gathered during the transects should be for relatively recent occurrences. Again, observer judgement is required. For occurrences that are clearly from previous years (e.g., dried and crumbling pellets, summer droppings (pies) that are dry and supporting growths of lichens or mosses, or fecal remains under last year's mat of annual vegetation),

the word "old" should be added under remarks. Such observations can be compiled separately or deleted later, if necessary. If age is not clear, the occurrence should not be labelled as "old." Pellets, for instance, can fade and crack on the surface relatively quickly under hot, dry conditions, and carnivore droppings, which often contain a high amount of calcium material, can turn white and "old looking" in a matter of days.

Figure 17 illustrates data entries for some occurrences of feces that might be encountered along a transect in a regenerating burn (Habitat "o", segment number in parentheses): two old moose pellet groups (13), one unidentified small carnivore scat (14), an unidentified pellet group (15), five occurrences of snowshoe hare pellets and one raptor pellet (16).

Note in Figure 17 that although there were five separate occurrences of hare pellets in segment 16, the maximum recorded for any particular kind of occurrence is three per segment ("1 1 1", under "Number"). The additional occurrence in segment 16 is for the new species (rapt). Note also that the description information in Form WM-3 is not limited to one line; the more description provided, the greater the likelihood of obtaining an identification. For example, in the case of the observation in segment 15, the relatively small size of the opening in the hollow log where the pellets were found would rule out all species too large to enter.

Browsing (BR): The term as used here refers to sign of feeding on woody vegetation, mostly shrubs but also including small trees. Most browsing activity is attributable to ungulates which, because they lack upper incisors, rip rather than snip off twigs and small branches, leaving a jagged edge on the remaining material. Rodents and hares, on the other hand, snip twigs off neatly, leaving a smooth, diagonal surface at the cut end. The various "types" of this sign class are particular shrubs and trees that are commonly browsed; the sub-types indicate three classes of browsing intensity. Thus, a lightly browsed shrub is one on which no more than 15% of the available twigs have been removed (visual estimate); and a heavily browsed shrub shows use of more than 65% of the available twigs. This category of sign is another of those for which quantification can be difficult. On the basis of "separate occurrences," browsing on a small shrub consisting of a single stem would be listed as a single record, as would browsing on a larger multi-

FORM WM-2A (DATA SHEET)

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
13	ALAL	SC	PT -	1 1	O	Old
14	unca	SC	CD - 1	1	"	
15	unma	SC	PT -	1	"	Collected; see WM-3:15
16	LEAM	SC	PT -	1 1 1	"	
16	rapt	SC	PT -	1	"	Collected; see WM-3:16

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
15	Pellet sample (DLA0001-A-15) from 100+ found at the entrance of a hollow log: opening in log 14.2 cm max. diameter.
16	Pellet (DLA0001-A-16) found at the base of a spruce tree with white fecal stains nearby; contains at least one rodent skull (sp?)

FIGURE 17. Examples of data entries for occurrences of fecal remains.

stem shrub within a particular segment. For the case in which a patch of shrubs, all browsed, extends continuously along the entire 10-m segment, the number designation would be "1 1 1", indicating three or more occurrences.

Figure 18 shows some examples of data entries for occurrences of browsing in an open aspen stand (Habitat Unit "f"). It includes a light degree of leaf stripping on a birch by an unknown ungulate (segment 17), four occurrences of heavy moose browsing in a patch of willows (18), light use of a pine by snowshoe hares (19), and two occurrences of moderate browsing on Douglas maple by deer (20).

Other Feeding Sign (FS): This sign class involves a variety of animal feeding evidence other than browsing. The most common of these are listed as "types" on the data codes form (WM-2B), and are briefly described and discussed below. No separate sub-types are recognized. For difficult-to-identify occurrences, good descriptions under "Remarks" or on Form WM-3 are recommended and a photograph may be useful (see Section 2.1.4).

- Barking refers to the removal of bark from standing or fallen woody stems and branches, and may be attributable to a number of wildlife species including ungulates, hares, squirrels, porcupines, beavers, voles, and bears. The species involved in any particular situation may be determinable from the position, extent, and nature of the damage (see Harestad *et al.* 1986). Ungulates, hares, and rodents usually gnaw the surface, leaving tooth marks in varying sizes and patterns that can be diagnostic; bears pull the bark off in strips. Damage high in a tree is likely due to a climbing animal such as a squirrel or porcupine; that low on the base of a small tree or shrub is likely attributable to small rodents such as voles. For species that remain above the snow in winter (e.g., hares), feeding evidence may be higher than expected, based on the animal's size and climbing ability.
- Cutting, like browsing, involves the severing of woody stems and branches, and the distinction between these two categories of feeding sign is a fine one. In general, browsing is directed to branches and twigs, leaving the main stem intact; cutting removes the entire tree or shrub (e.g., beaver cuttings of poplar and willow, and hare or vole cuttings of pine saplings). However, the cone or bud-bearing twigs of conifers that may be scattered around the forest floor by squirrels are also more properly referred to as cuttings.
- Digging as used here refers to the disturbance or removal of soil for the purpose of finding food, and is therefore distinct from digging activities for other purposes such as construction of burrows and dens. Examples include excavations by badgers and wolverines in pursuit of ground squirrels, by coyotes and foxes to recover buried food items, and by bears to find roots and tubers.
- Grazing refers to feeding on herbaceous (non-woody) vegetation such as grasses, sedges, and various forbs, and is detectable primarily by incidence of clipped stems and leaves.

FORM WM-2A (DATA SHEET)

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
17	u n u n	B R	B B - 1	1	f	Small sapling (2 m high)
18	A L A L	B R	W I - 3	1 1 1	"	
19	L E A M	B R	P N - 1	1	"	
20	d e e r	B R	O T - 2	1 1	"	Douglas Maple

FIGURE 18. Examples of data entries for occurrences of browsing.

- Pawing is essentially "digging" in snow to expose vegetation beneath. It is mostly associated with ungulates such as caribou, mountain sheep, and horses, and is done to facilitate grazing, although moose will paw to get at low shrubs for browsing.
- Squirrel middens and feeding platforms are common in coniferous forest habitats. Both commonly feature concentrations of squirrel feeding evidence, especially piles of cone scales, but they occasionally include dried mushrooms and berry seeds and skins. The distinction between the two is that the feeding platform is simply a location, usually the top of a stump or downed log, where a squirrel has eaten one or a few cones or other items, while a midden is a very large collection of feeding evidence, often attributable to many generations of squirrels, and includes series of holes where cones have been buried or dug up.
- Log ripping is mainly attributable to bears, and involves the overturning or tearing apart of decaying logs in search of various potential food items including small rodents and insect larvae.
- Storing or "caching" refers to deliberate saving or preserving of food items for an animal's later use. Some examples include the cache of woody branches and twigs laid up by beavers in the fall, "hay" piles of drying herbaceous vegetation gathered by pikas and woodrats, mushrooms left to dry on conifer branches by squirrels, fish or frogs cached in a hollow log by a mink, or an ungulate carcass partially buried by a bear.
- Pecking evidence is not common, but may occasionally be encountered on suitable substrates such as the muddy edges of ponds and streams. It is characterized by small holes in the soil, made by birds pecking and probing for food items such as invertebrates. On wetter sites, tracks will usually also be present.
- Boring is reserved for the peck holes in woody vegetation made by woodpeckers, mostly in search of insects. In some cases, the holes may be the beginnings of nest cavities, but the "nest" category (under "Home Structures," below) does not apply until it is actually used for nesting. Boring may also apply to the reading of this field manual.

Figure 19 gives some examples of data entries for several kinds of other feeding sign, found in a spruce stand (segment number in parentheses): two squirrel feeding platforms and one midden (21), barking by an unknown mammal (22), woodpecker excavations on one tree (23), a mushroom cached in a tree (24), and a beaver-cut aspen (25). Note that additional information is provided in the remarks column for most of the occurrences, and that the woodpecker sign is listed as one occurrence because the multiple sign involved is concentrated at one location. Finally, the general category (trsq) is used for the species involved in the mushroom storing, since the observer is unsure whether it was a red squirrel or a flying squirrel.

Body Parts/Remains (BP): For the transect surveys, this sign class is subdivided into four types. The first two involve structures moulted or shed annually by live animals, including antlers as one type and various epidermal structures as the other. For the former, an observer must distinguish between shed antlers (separated from the skull cleanly at the base) and those at kill sites (usually with the skull or bone fragments attached at the base). The epidermal structures may include tufts of hair from mammals and entire shed skins of reptiles, but the most common item in most areas will be feathers. For the other two types, representing parts of dead animals at or near kill sites, a distinction is made between those at which bones are found (making them somewhat more identifiable) and those with only scattered epidermal remains (usually hair or feathers).

Figure 20 shows data entries for the following occurrences of remains found in a regenerating cutblock (Habitat Unit "p" in Form WM-1B): a skull from a bull moose (26), a tail feather from a Ruffed Grouse (27), a snowshoe hare kill site (28), and an unidentified tuft of hair that is collected (29). In the case of the skull, found sunken into the soil, rodent chewed and covered with lichens, the remark comment "old" applies.

FORM WM-2A (DATA SHEET)						
(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
21	T A H U	F S	F P -	1 1	b	
21	T A H U	F S	M D -	1	"	Very large
22	u n m a	F S	B K -	1	"	See note, WM - 3: 22
23	w d p k	F S	B O -	1	"	Several holes in one tree
24	t r s q	F S	S T -	1	"	Mushroom on spruce branch
25	C A C A	F S	C U -	1	"	Felled aspen

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)	
(I) OBS. NO.	(II) REMARKS
22	Several branches and most of the trunk of a pine, 8-12 m above the ground, are peeled clean of bark; there were numerous bark chips 2-3 cm in diam. at base of tree.

FIGURE 19. Examples of data entries for "other feeding sign."

FORM WM-2A (DATA SHEET)						
(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
26	A L A L	B P	K S -	1	P	Skull w/large antlers (old)
27	R U G R	B P	E P -	1	"	Tail feathers (gray phase)
28	L E A M	B P	K E -	1	"	Patch of white hair
29	u n m a	B P	E P -	1	"	Collected; see WM - 3: 29

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)	
(I) OBS. NO.	(II) REMARKS
29	Tuft of hair found stuck to pitch, about 1.5 m above the ground on a spruce tree; specimen No. DLA0001-A-29.

FIGURE 20. Examples of data entries for body parts and remains.

Tracks and Trails (TT): Tracks are individual or sets of footprints; trails are beaten paths from repeated travel by one or more animals. For tracks, distinction is made between those in soil and those on snow. Tracks in soil are mostly found opportunistically, on a suitable substrate such as a dusty road or a mudbank beside a water body. This category could also be re-defined to include tracks located on artificial substrates (sand, smoked paper, chalk plates) placed out for that purpose.

Tracks in snow are usually the primary data sought on winter transects (Section 2.4). Two types, relating to direction of travel relative to the observer's position (right or left), are obtainable in most snow conditions, but the type code "SN" applies where such distinction cannot be made. Direction of travel data may be used to assess the number of different animals involved in track counts (e.g., one track to the left and three to the right within a short distance suggests the presence of at least three animals). In addition, such data may help to identify particular travel corridors and times (e.g., when most tracks of particular species or groups of species head in only one direction). A potentially troublesome occurrence is that in which a track direction is parallel to that of the observer, and remains within the transect boundary for some distance. When that is clearly the case, the number of occurrences for each of the segments involved is _ _ 1, and remarks, after the first occurrence, should indicate something like "same moose."

Trails vary both in size (width) and in their apparent intensity of use, ranging from faint depressions on ground vegetation to virtual "highways" worn deep into mineral soil. The three sub-types under trails refer only to the size differences, as indicators of the size of the main species using them. Other features, such as conspicuousness, should be noted in the remarks column or on Form WM-3. The small trails (runways) of voles, which are usually (but not always) associated with burrows, are considered a special case under "Home Structures," and are therefore excluded from the tracks and trails category.

Figure 21 gives data entries for some fictitious track and trail occurrences in balsam: a black bear track and an unidentified canid (dog family) track in mud (30), one marten track to the left and two to the right on snow (31), and a small trail on a mossy forest floor (32). Note that measurement of bear tracks (greatest width across the front pad) may help to confirm the presence of two or more individuals in the area of interest. Measurement of the canid track may help to identify species. Two entries are given for the marten tracks, since they involve two sub-types of occurrences (i.e., left and right).

Home Structures (HM): This class of sign includes special structures dug, built or secondarily occupied by animals as shelter from climatic conditions, protection from enemies, or production of young. Several sign types are listed on the data codes form:

- Burrows are usually holes in the soil with a more or less circular outline at the entrance. They are generally associated with rodents and certain seabirds. The presence of disturbed soil or animal debris, such as feces or food remains at the entrance, indicates a burrow is active. Dens are essentially large burrows, mostly associated with carnivores ranging in size from weasels to bears. Except for size, bear dens in soft soil may look identical to ground squirrel burrows

FORM WM-2A (DATA SHEET)

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
30	U R A M	T T	T X - _	_ _ 1	C	Front pad 15.2 cm wide
30	u n d f	T T	T X - _	_ _ 1	"	4.2 cm wide by 5.3 cm long
31	M A A M	T T	S L - _	_ _ 1	"	
31	M A A M	T T	S R - _	_ 1 1	"	
32	u n m a	T T	T L - 1	_ _ 1	"	Faint, on moss

FIGURE 21. Examples of data entries for tracks and trails.

in the same area, although some dens take advantage of natural openings such as rock caves and the hollows under tree roots. There are three sub-types of burrows and dens, consisting of size categories of entrance diameters.

- Beaver lodges and muskrat push-ups are both associated with aquatic environments. Lodges are usually constructed of sticks and mud and, although they may be completely surrounded by water, they often merely extend out into the water from a connection on land; push-ups, on the other hand, are constructed primarily of soft aquatic vegetation and are surrounded by water.
- Nests are mostly associated with birds, and may be found in trees (including cavities) or on the ground. An observer may determine the identity of species by seeing adults flushed from, or anxious about, the nest location; but in most cases, a description or photograph of the nest and contents (if accessible) will be necessary . The size, shape, and composition of the nest, the nature of the material lining the nest, and the size, shape, number, and colour of eggs may all be diagnostic (Harrison 1978). Some mammals also construct and use nest-like structures. Included are the wads of grass that serve as winter nests for voles beneath the snow, and squirrel tree nests made of twigs, leaves, and bark.
- Vole runways and tunnels are listed under home structures because they generally occur in networks that include their burrows as well. Runways are particularly characteristic of vole occurrence in grasslands, and show up best in spring before green-up. Tunnels are primarily runways in snow. Note that under the species designations (Form WM-2B), the general code "unro" applies to any small "mouse-size" mammal and may often be used in association with this sign type.

Figure 22 shows data entries for observations in the "home structures" category: four occurrences of vole runways and burrows (33), a Red-tailed Hawk nest (34), a larger mammal burrow (35), and the

FORM WM-2A (DATA SHEET)

(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
33	m i c r	H M	V R -	1 1 1	g	
34	h a w k	H M	N S -	1	"	Red-tailed Hawk (WM - 3:34)
35	u n m a	H M	B u - 3	1	"	Woodchuck ?
36	p a s s	H M	N S -	1	"	see WM - 3:36

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
34	Large stick nest 15 m up in a cottonwood tree; both parents
	(one dark phase & one light) circling & calling nearby.
36	Nest a cup of grasses at the base of a grass clump, lined w/a few
	dark hairs; 5 eggs, pale blue w/brown spots -- heaviest spots
	on large end: eggs oval, averaging about 17 x 22 mm.

FIGURE 22. Examples of data entries for home structures.

nest of an unidentified small passerine or "dicky bird" (36). Points to note include identification of the hawk nest (primarily on the basis of observation of the parent birds), the measurement and guess of species associated with the burrow, and the amount of detail provided in the description of the passerine nest.

Miscellaneous Structures (MS): This category, particularly under the sign type "Other," is a catch-all for a number of kinds of wildlife sign that do not clearly fit into any of the other categories. The three specific examples listed on the data codes form are described and briefly discussed below:

- Antler trees are those that have been "rubbed" (often thrashed) by male members of the deer family with their antlers. The full social context of that activity cannot be described here, but it accompanies the fall shedding of the velvet and preparation for rut. Antler trees, often small conifers but occasionally even deciduous shrubs, usually have most of their bark and branches removed by antler rubbing, and are virtually destroyed.
- Large mammal bed sites are distinct areas of compressed vegetation or depressions in snow where large mammals have bedded down. Tracks or droppings usually provide clues as to the species involved, although that is not always the case.
- Beaver dams and canals are flood control and access structures built by the animals, and are usually conspicuous and easy to recognize.
- Dust baths are used by wild birds, especially grouse, in much the way domestic chickens use them. Dusting sites usually appear as slight depressions, 30–40 cm in diameter, in dry soil. If regularly used, they may be conspicuous bare patches on otherwise vegetated ground, and feathers may be found in the vicinity.

Figure 23 provides examples of data entries for three occurrences in the miscellaneous structures category: a moose antler-rub tree (37), bear claw marks on an aspen (38), and a bed-site of an unidentified large mammal (39). Note that nearby beds and fecal pellets provided the clue to the identity of the ungulate species using the rub tree; the bear climb marks on the tree constitute an unlisted sign type; and the absence of other sign made it impossible to identify the species that used the bed.

FORM WM-2A (DATA SHEET)

(I) SEGMENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
37	A L A L	M S	A T -	1	K	See WM - 3:37
38	U A A M	M S	N L -	1	"	Claw marks and tracks
			-		"	on an aspen (climbed)
39	u n m a	M S	B D -	1	"	See WM - 3:39

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
37	Small pine, about 2.2 m high; several beds and moose pellet groups
	nearby, indicating it was the species involved.
39	Depression and flattened vegetation about 1.8 x 0.7 m, but no
	associated tracks, droppings, or other sign.

FIGURE 23. Examples of data entries for miscellaneous structures.

Small Mammal Trapping (TR): For those transects on which small mammal traplines are established (Section 2.5), all field data related to trapping are recorded in this sign class. The four sign types listed describe the status of individual traps:

- Unsnapped refers to traps that remain set and ready to catch animals, regardless of whether or not the bait has been disturbed.
- Snapped but empty indicates a trap that has been set off without capturing an animal. This category applies whether or not animals were involved in springing the trap.
- Trap missing indicates traps that are not found and whose status can therefore not be determined. It applies whether the missing trap is suspected to have been carried away by an animal, or it has simply been misplaced (human error).
- Animal captured applies when a snapped trap is holding an animal.

Trapping effort and success rates are calculated on the basis of "trap nights." One trap set out over one night is one trap night. The main function of the sub-types associated with the above sign types is to ensure that the status of both traps at each station are recorded and therefore all trap nights are accounted for. In most cases, it does not matter which trap is called "Trap 1" and which "Trap 2" on any given day — those labels refer to the order of listing and not necessarily to particular traps. However, the two traps may be specifically labelled if some aspect of their placement is being tested. For example, all of the Trap 1's on a particular transect may be baited with peanut butter and all Trap 2's with cheese, or all Trap 1's set under fallen trees and all Trap 2's on top.

Although most trapping sessions on transects will involve only two trap checking days, the sub-type codes given on Form WM-2B provide for sessions with up to four checking days. Thus, for a two-day session, the sub-types for the (maximum) four trap check entries will be 1, 2, 5, and 6. There may be fewer than four entries for a two-day session if one or both traps were missing on the first day and could not be replaced. Figure 24 provides examples of two-day data entries for two trap stations (at 17 m and 67 m along the transect), given the following results: Day 1 — one red-backed vole and one shrew caught at 17, and one unsnapped and one missing trap (not replaced) at 67; Day 2 — one snapped empty trap and one deer mouse at 17, and one unidentified "mouse" at the single remaining trap at 67. There are two main points to note in Figure 24. The first is the relegation of the trap stations to the transect segments in which their centres occur (i.e., 17 is in segment 2 and 67 in segment 7). The other is the addition of a number in parentheses to the specimen label (1 or 2 in the present example), to indicate the trap check day. This will enable separation of small mammals of the same species caught at the same trap station on different days, in case that becomes a point of interest. For example, if certain classes of animals

FORM WM-2A (DATA SHEET)						
(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
2	r b v o	T R	C P - 1	1	r	Specimen DLA0001-A-2(1)
2	u n s h	T R	C P - 5	1	"	" " " " "
7		T R	U S - 1	0	"	
7		T R	M S - 5	0	"	
2		T R	E M - 2	0	"	
2	P E M A	T R	C P - 6	1	"	Specimen DLA0001-A-2(2)
7	u n r o	T R	C P - 6	1	"	" " " 7(2)

FIGURE 24. Examples of data entries for small mammal trapping results.

appeared in the catch mostly on days 3 or 4 of longer trapping sessions, standardizing the trapping to those longer sessions might be appropriate.

3.4 Incidental Observations and Notes Form (WM-3)

The use of this form (Fig. 25) will be apparent from the numerous foregoing examples. It is essentially an expansion of the "Remarks" column on the data form (WM-2A), providing not only for entry of true "incidental observations (i.e., those outside transect boundaries), but also for more expansive descriptive notes on unidentified sign or elaboration on locations, habitats, or quantity of sign.

4 DATA COMPILATION AND ANALYSIS

Most of the data from the two-person transect method can be transferred directly to a computer spreadsheet or database file, under the same headings and codes as on the field data form (WM-2A). The first step is to review and edit the generic designations under "Species" (Column II of the data form), to ensure that the identification of each has been taken as far as possible. Collected specimens and the additional descriptive information provided in the "Remarks" column and the incidentals form (WM-3) should be checked in consultation with experts and the literature.

In the office, for example, the general designation (wdpk) for an unidentified woodpecker could be changed to its correct species (Three-toed Woodpecker = TTWO), based on the description ". . . mostly black, but with a white patch on the back and yellow on the head." Likewise, laboratory examination of a collected feather might result in "bumping up" the general designation "unbd" (unidentified bird) to the more specific "owlg" (owl, general). For the cases in which closer identification does not seem possible, it is still a good idea to preserve the specimens and descriptive information, since further field experience may clarify some kinds of occurrences later, and the database can always be edited.

Figure 26 provides an example of computer entries for the field form data shown in Figure 16. The important point is that each entry be labelled with the appropriate Project and Transect ID code, in the form "Project Number-Transect Letter" (column 1). Note, too, that the remarks entry for nuthatch on the data form is no longer necessary on the database, since it simply identified the correct species and the species column has been edited accordingly. In general, field remarks taken to help in identification are not necessary on the database; those that provide additional information on abundance, location, habitat, or some other aspect of natural history should be transferred to the database.

In the case of one-person surveys, a transcript of the tape-recorded field notes can be prepared as recorded. To be compatible with the results from two-person surveys, however, the one-person survey results must be transferred to the database format. This can be done either from the tape recorder or the transcript, with distance measurements being converted to the appropriate segment numbers and the narrative on species and sign to the data codes, as required. Figure 27 provides an example of such a conversion for data from a regenerating clearcut, on both forms WM-2A and WM-3.

In this example, note: seven observations of vole burrows and runways translate to three vole occurrences in terms of segments. The initial four are all in segment 63, and the last three occur in two different segments (two in 69 and one in 70). No observations are shown for the distance interval between 629 and 642. Because this interval includes the entire segment 64 (631–640), it is apparent that segment 64 should be listed as having no wildlife sign. Three other segments (66, 67, and 71) are also in that category. Remarks, shown for three occurrences, are as they would be recorded by a two-person team on the appropriate field forms.

Data analysis, using the database compilations, can provide summaries of occurrence and comparisons for particular project areas, whole or partial transects, and habitat units, in terms of particular species, species groups, and even categories of sign. Analysis procedures, together with examples of results for areas studied during the field method development stage, are given in Hatler.[6]

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[6] Hatler, 1992.

WILDLIFE MONITORING FORM (WM-3)

INCIDENTAL OBSERVATIONS AND NOTES

PROJECT ID NO. _ _ _ _ _ _ _ _ PAGE __ OF __

(I) OBS. NO.	(II) REMARKS

FIGURE 25. The Incidental Observations and Notes Form (WM-3).

FORM WM-2A (DATA SHEET)						
(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
9	TAHU	DC	HR-1	1	b	
10	RUGR	DC	SE-3	1	"	Hen w/6 downy chicks
11	nuha	DC	SE-1	1	"	Red-breasted...
11	BCCH	DC	SE-1	1	"	Same tree w/nuthatch
12	wdpk	DC	HR-1	1	"	Hammering... not seen

DATABASE ENTRIES

PROJECT	TRANSECT ID	(I) SEG-MENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
DLA0001	A	9	TAHU	DC	HR-1	1	b	
DLA0001	A	10	RUGR	DC	SE-3	1	b	Hen with 6 downy chicks.
DLA0001	A	11	RBNU	DC	SE-1	1	b	
DLA0001	A	11	BCCH	DC	SE-1	1	b	Same tree with nuthatch.
DLA0001	A	12	wdpk	DC	HR-1	1	b	Hammering, not seen.

FIGURE 26. Examples of data transfer to computer database.

TAPE TRANSCRIPT

Moose browsed shrub--willow, heavy (615), vole burrows and runways (621, 623, 625, 629), fresh! bear scat, with Black Bear tracks nearby (642), moose pellets (671), vole burrows and runways (681, 687, 697), pair of anxious Common Snipes--nest nearby? (711), small cord type dropping containing hair and bone--3 mm diameter (719), tuft of hair found stuck in a crack on a high stump, 1.2 m above the ground, collected, Specimen No. DPG0001-A-73 (729).

FORM WM-2A (DATA SHEET)

(I) SEGMENT NO.	(II) SPECIES	(III) SIGN CLASS	(IV) SIGN TYPE	(V) NUMBER	(VI) HABITAT UNIT	(VII) REMARKS
62	ALAL	BR	WI-3	1	P	
63	micr	HM	VR-	111	"	
64		NN	-	0	"	
65	URAM	SC	CD-4	1	"	Fresh; contains horsetail
66		NN	-	0	"	
67		NN	-	0	"	
68	ALAL	SC	PT-	1	"	
69	micr	HM	VR-	11	"	
70	micr	HM	VR-	1	"	
71		NN	-	0	"	
72	COSN	DC	SE-2	1	"	Anxious pair ... nest near?
72	uncu	SC	CD-1	1	"	
73	unma	BP	EP-	1	"	Collected; see WM-3:73

FORM WM-3 (INCIDENTAL OBSERVATIONS AND NOTES)

(I) OBS. NO.	(II) REMARKS
73	Tuft of hair found wedged in a crack on a stump, 1.2 m above the ground. Specimen No. DPG0001-A-73.

FIGURE 27. Example of data conversion from tape-recorder transcript to the standard data forms.

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APPENDIX 1. Example of a completed Project Information Form

WILDLIFE MONITORING FORM (WM-1A)
PROJECT INFORMATION

Project ID Number D L A 0 0 0 1

Has MoE/MoF Environmental Monitoring been completed (Yes___ No ✓)
or is it in progress (Yes___ No ✓) in the study area?

If yes to either, enter relevant Project ID Number above (from Form EM-1).

If no to both, assign new 7-digit ID number above, and provide location and site description information in the box below (items 2 - 4).

2) MoE Region - Mgmt Unit 6 - 04. 3) Mapsheet 93F

4) Biogeoclimatic Zone and Subzone SBSmc

5) Ecoregion Fraser Plateau Ecosection BuB

6) Project Area:
a) FRDA Research Study area (Project No. 1-13), or...
b) FRDA Operational Reforest. area (Proj. No. ____), or...
c) Other (Describe)____

7) Project Coordinator(s) David F. Hotler

8) Agency XWIL (Wildeor Wildlife Research + Consulting)

9) Objective (select 1 from list below, by letter): f

Baseline Data for: a) Single habitat unit; b) Several habitats or habitat units (regional); c) Area proposed for development; d) Other (specify) ____

Comparative Data (treatment areas + controls) for: e) forest harvesting methods; f) silviculture research; g) silviculture operations; h) wildfire; i) Prescribed burn; j) wildlife habitat enhancement; k) Other (specify) ____

10) Number of Transects 12

11) Transect ID's M N O P Q R S T U V W X

12) Attach map(s) or airphoto(s), or provide a diagram in the box on the reverse side of this form, identifying or showing:

- The overall project area, labelled with the Project ID Number.
- Scale (map or air photo only).
- All transects, labelled with their ID code letters and showing direction of travel.
- Baseline for selection and orientation of transects, if present.
- Pertinent landmarks as related to the boundaries of the project area, the baseline, and/or the position of one or more of the transects; indicate associated distances from landmarks to project features where appropriate.

The project area and transect locations are shown on (check one or more):
a) Attached map(s): ✓ Number 1 Code(s) 93 F/13.

b) Attached airphoto(s): ___ Number __ Code(s) ____.

c) Diagram (over): ✓. **(See Figure 9, Page 22)**

APPENDIX 2. Example of a completed Transect Information Form

WILDLIFE MONITORING FORM (WM-1B)
TRANSECT INFORMATION

TRANSECT P PROJECT ID NO. D L A 0 0 0 1

13) Observer(s): Tania S. and Silene F. Hatler

14) Survey Date: 89, 08, 23 (YY MM DD) 15) Survey Times: Start 16:25 End 18:10

16) Weather Conditions Clear, warm (to 25°C), with light wind.

17) Ground snow covered? Yes__, No✓. If yes, per cent coverage ____%, average depth (cm) _____, and number of days since last snowfall _____.

18) Small Mammal Trapline? Yes✓, No__. If yes, first station location 21.

19) Herpetofauna Search? Yes__, No✓. If yes, first station location ____.

20) Habitat Unit or habitats sampled: If transect is restricted to a single habitat unit from a previous or current environmental monitoring project, enter the Sample No. from Form EM-2 _____. Otherwise, select habitats from the list below, and enter in order from start to end of transect: a, r_1, r_2, a, __, __, __, __, __.

Mature Conifer Forest:	Deciduous Forest:	l) riparian shrub; m) wetland;
a) pine dominated	f) aspen dominated	n) herb/forb meadow
b) spruce dominated	g) cottonwood dominated	o) regenerating burn (wildfire)
c) balsam dominated	h) birch dominated	p) regenerating cutblock
d) other (specify _____)	i) other (specify _____)	r) research/enhancement plot
e) mixed (specify _____)	j) mixed (specify _____)	s) other (specify): _____
k) conifer/deciduous mix (specify _____)		

21) Site History for disturbed or manipulated habitat unit or habitats (o,p,r, s, above) crossed by this transect; for habitats in the same category but with different histories, use subscripts, e.g. p_1, p_2, p_3...

Habitat ___ History _____
Habitat r_1 History Knocked down + broadcast burned, spring 1986.
Habitat r_2 History Knocked down, windrowed + burned, fall 1986.
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____
Habitat ___ History _____

22) Attach map(s) or airphoto(s), or provide a diagram in the box on the reverse side of this form, identifying or showing:

a) Approximate scale.
b) The transect, showing start (SS) and end (EE) points.
c) Transect bearings (based either on magnetic or true north, but indicate which).
d) One or more pertinent landmarks as related to the position of the transect; indicate associated distances where appropriate.
e) Habitat Unit/Habitats, labelled as in items 19 and 20, above.

The transect location and orientation are shown on (check one or more):
a) Attached map: ___ Number __ Code _____.

b) Attached airphoto: ___ Number __ Code_____.

c) Diagram (over): ✓. **(See Figure 11, Page 26)**

APPENDIX 3. Species codes for land vertebrates that might be encountered during ground transects in British Columbia

This is a selected list, including all species with three or more known occurrences in the province, and/or those whose B.C. status is not well known but regular occurrence is possible. Common names and order of listing are as given in Cannings and Harcombe (1990); that source should be consulted for applicable scientific names and for codes of the few species not listed here. Codes for known species (all caps) correspond to the last four characters of the codes provided by Cannings and Harcombe (1990), except those for four species (Sharp-tailed Snake, European Skylark, Harbor Seal, and Cascade Mantled Ground Squirrel) have been changed slightly to prevent duplication. Codes in lower case are for generic observations (i.e., species not confirmed).

SPECIES	PAGE/COLUMN
AMPHIBIANS	
Salamanders and Newts	50/1
Frogs and Toads	50/1
REPTILES	
Turtles	50/1
Lizards	50/1
Snakes	50/1
BIRDS	
Loons	50/1
Grebes	50/2
Tubenoses	50/2
Pelicans and Cormorants	50/2
Tall Waders (Herons, Egrets, Ibises and Storks)	50/2
Waterfowl (Swans, Geese and Ducks)	50/2
Vultures, Eagles and Hawks	51/1
Grouse, Quail and Allies	51/1
Rails and Cranes	51/2
Shorebirds (Plovers, Sandpipers and Allies)	51/2
Gulls and Terns	52/1
Alcids	52/1
Pigeons and Doves	52/1
Cuckoos	52/1
Owls	52/1
Goatsuckers	52/2
Swifts and Hummingbirds	52/2
Kingfishers	52/2
Woodpeckers	52/2
Flycatchers	52/2
Larks	53/1
Swallows	53/1
Jays, Crows, and Magpies	53/1
Chickadees and Bushtits	53/1
Nuthatches and Creepers	53/1

SPECIES	PAGE/COLUMN
BIRDS (continued)	
Wrens and Dippers	53/1
Kinglets, Bluebirds and Thrushes	53/1
Mockingbirds and Thrashers	53/2
Wagtails and Pipits	53/2
Waxwings	53/2
Shrikes	53/2
Starlings	53/2
Vireos	53/2
Warblers and Allies	53/2
Sparrows and Allies	54/1
Blackbirds and Allies	54/1
Finches	54/1
MAMMALS	
Marsupials	54/2
Shrews and Moles	54/2
Bats	54/2
Rabbits, Hares and Pikas	54/2
Mountain Beavers	55/1
Voles and Lemmings	55/1
Beavers	55/1
New World Mice and Rats	55/1
Miscellaneous Rodents	55/1
Old World Mice and Rats	55/1
Myocastorids	55/1
Sciurids (Marmots, Squirrels and Chipmunks)	55/1
Jumping Mice	55/2
Canids	55/2
Felids	55/2
Weasels and Allies	55/2
Pinnipeds (Seals and Sea Lions)	55/2
Procyonids	55/2
Bears	55/2
Ungulates	55/2

No.	SPECIES (CODE)
AMPHIBIANS	
Salamanders and Newts	
001)	Rough-skinned Newt (TAGR)
002)	Northwestern Salamander (AMGR)
003)	Long-toed Salamander (AMMA)
004)	Tiger Salamander (AMTI)
005)	Pacific Giant Salamander (DIEN)
006)	Clouded Salamander (ANFE)
007)	Ensatina (ENES)
008)	Coeur d'Alene Salamander (PLID)
009)	Western Red-backed Salamander (PLVE)
010)	unidentified salamander/newt (sala)
Frogs and Toads	
011)	Tailed Frog (ASTR)
012)	Great Basin Spadefoot Toad (SCIN)
013)	Western Toad (BUBO)
014)	unidentified toad (toad)
015)	Pacific Treefrog (HYRE)
016)	Striped Chorus Frog (PSTR)
017)	Red-legged Frog (RAAU)
018)	American Bullfrog (RACA)
019)	Green Frog (RACL)
020)	Northern Leopard Frog (RAPI)
021)	Spotted Frog (RAPR)
022)	Wood Frog (RASY)
023)	unidentified frog (frog)
024)	unidentified tadpole (tdpl)
025)	***Unidentified Amphibian (unam)***
REPTILES	
Turtles	
026)	Snapping Turtle (CHSE)
027)	Reeves' Turtle (CHRE)
028)	Painted Turtle (CHPI)
029)	Western Pond Turtle (CLMA)
Lizards	
030)	Short-horned Lizard (PHDO)
031)	Western Skink (EUSK)
032)	Northern Alligator Lizard (GECO)
033)	unidentified lizard (liza)
Snakes	
034)	Rubber Boa (CHBO)
035)	Western Yellow-bellied Racer (COMO)
036)	Sharp-tailed Snake (CONT)
037)	Night Snake (HYTO)
038)	Gopher Snake (PIME)
039)	Ground Snake (SOSE)
040)	Western Garter Snake (THEL)
041)	Northwestern Garter Snake (THOR)
042)	Common Garter Snake (THSI)
043)	Western Rattlesnake (CRVI)
044)	unidentified snake (snak)
045)	***Unidentified Reptile (unrp)***
BIRDS	
Loons	
046)	Red-throated Loon (RTLO)
047)	Pacific Loon (PALO)
048)	Common Loon (COLO)
049)	Yellow-billed Loon (YBLO)

No.	SPECIES (CODE)
Loons (continued)	
050)	unidentified loon (loon)
Grebes	
051)	Pied-billed Grebe (PBGR)
052)	Horned Grebe (HOGR)
053)	Red-necked Grebe (RNGR)
054)	Eared Grebe (EAGR)
055)	Western Grebe (WEGR)
056)	Clark's Grebe (CLGR)
057)	unidentified grebe (greb)
Tubenoses	
058)	Fork-tailed Storm-Petrel (FTSP)
059)	Leach's Storm-Petrel (LSPE)
Pelicans and Cormorants	
060)	American White Pelican (AWPE)
061)	Brown Pelican (BRPE)
062)	Double-crested Cormorant (DCCO)
063)	Brandt's Cormorant (BRCO)
064)	Pelagic Cormorant (PECO)
065)	unidentified cormorant (corm)
Tall Waders (Herons, Egrets, Ibises and Storks)	
066)	American Bittern (AMBI)
067)	Great Blue Heron (GBHE)
068)	Great Egret (GREG)
069)	Snowy Egret (SNEG)
070)	Little Blue Heron (LBHE)
071)	Cattle Egret (CAEG)
072)	Green-backed Heron (GRHE)
073)	Black-crowned Night-Heron (BCNH)
074)	White-faced Ibis (WFIB)
075)	unidentified tall wader (wade)
Waterfowl (Swans, Geese and Ducks)	
076)	Tundra Swan (TUSW)
077)	Trumpeter Swan (TRUS)
078)	Mute Swan (MUSW)
079)	unidentified swan (swan)
080)	Greater White-fronted Goose (GWFG)
081)	Snow Goose (SNGO)
082)	Ross' Goose (ROGO)
083)	Emperor Goose (EMGO)
084)	Brant (BRAN)
085)	Canada Goose (CAGO)
086)	unidentified goose (goos)
087)	Wood Duck (WODU)
088)	Green-winged Teal (GWTE)
089)	American Black Duck (ABDU)
090)	Mallard (MALL)
091)	Northern Pintail (NOPI)
092)	Garganey (GARG)
093)	Blue-winged Teal (BWTE)
094)	Cinnamon Teal (CITE)
095)	Northern Shoveler (NOSL)
096)	Gadwall (GADW)
097)	Eurasian Wigeon (EUWI)
098)	American Wigeon (AMWI)
099)	unidentified dabbling duck (dabb)
100)	Canvasback (CANV)
101)	Redhead (REDH)
102)	Ring-necked Duck (RNDU)

No.	SPECIES (CODE)
Waterfowl (continued)	
103)	Tufted Duck (TUDU)
104)	Greater Scaup (GRSC)
105)	Lesser Scaup (LESC)
106)	Common Eider (COEI)
107)	King Eider (KIEI)
108)	Steller's Eider (STEI)
109)	Harlequin Duck (HADU)
110)	Oldsquaw (OLDS)
111)	Black Scoter (BLSC)
112)	Surf Scoter (SUSC)
113)	White-winged Scoter (WWSC)
114)	Common Goldeneye (COGO)
115)	Barrow's Goldeneye (BAGO)
116)	Bufflehead (BUFF)
117)	unidentified diving duck (dive)
118)	Smew (SMEW)
119)	Hooded Merganser (HOME)
120)	Common Merganser (COME)
121)	Red-breasted Merganser (RBME)
122)	unidentified merganser (merg)
123)	Ruddy Duck (RUDU)
Vultures, Eagles and Hawks	
124)	Turkey Vulture (TUVU)
125)	Osprey (OSPR)
126)	Bald Eagle (BAEA)
127)	Northern Harrier (NOHA)
128)	Sharp-shinned Hawk (SSHA)
129)	Cooper's Hawk (COHA)
130)	Northern Goshawk (NOGO)
131)	unidentified accipiter (acci)
132)	Broad-winged Hawk (BWHA)
133)	Swainson's Hawk (SWHA)
134)	Red-tailed Hawk (RTHA)
135)	Ferruginous Hawk (FEHA)
136)	Rough-legged Hawk (RLHA)
137)	Golden Eagle (GOEA)
138)	unidentified eagle or hawk (hawk)
139)	American Kestrel (AMKE)
140)	Merlin (MERL)
141)	Peregrine Falcon (PEFA)
142)	Gyrfalcon (GYRF)
143)	Prairie Falcon (PRFA)
144)	unidentified falcon (falc)
145)	unidentified raptor (rapt)
Grouse, Quail and Allies	
146)	Gray Partridge (GRPA)
147)	Chukar (CHUK)
148)	Ring-necked Pheasant (RNPH)
149)	Spruce Grouse (SPGR)
150)	Blue Grouse (BLGR)
151)	Willow Ptarmigan (WIPT)
152)	Rock Ptarmigan (ROPT)
153)	White-tailed Ptarmigan (WTPT)
154)	unidentified ptarmigan (ptar)
155)	Ruffed Grouse (RUGR)
156)	Sharp-tailed Grouse (STGR)
157)	unidentified grouse (grou)
158)	Wild Turkey (WITU)
159)	California Quail (CAQU)
160)	Mountain Quail (MOQU)

No.	SPECIES (CODE)
Grouse, Quail and Allies (continued)	
161)	unidentified quail (quai)
Rails and Cranes	
162)	Virginia Rail (VIRA)
163)	Sora (SORA)
164)	American Coot (AMCO)
165)	Sandhill Crane (SACR)
166)	Whooping Crane (WHCR)
Shorebirds (Plovers, Sandpipers, and Allies)	
167)	Black-bellied Plover (BBPL)
168)	Lesser Golden Plover (LGPL)
169)	Snowy Plover (SNPL)
170)	Semipalmated Plover (SEPL)
171)	Killdeer (KILL)
172)	unidentified plover (plov)
173)	Black Oystercatcher (BLOY)
174)	Black-necked Stilt (BNST)
175)	American Avocet (AMAV)
176)	Greater Yellowlegs (GRYE)
177)	Lesser Yellowlegs (LEYE)
178)	Spotted Redshank (SPRE)
179)	Solitary Sandpiper (SOSA)
180)	Willet (WILL)
181)	Wandering Tattler (WATA)
182)	Spotted Sandpiper (SPSA)
183)	Upland Sandpiper (UPSA)
184)	Whimbrel (WHIM)
185)	Long-billed Curlew (LBCU)
186)	unidentified curlew (curl)
187)	Hudsonian Godwit (HUGO)
188)	Bar-tailed Godwit (BTGO)
189)	Marbled Godwit (MAGO)
190)	unidentified godwit (godw)
191)	Ruddy Turnstone (RUTU)
192)	Black Turnstone (BLTU)
193)	Surfbird (SURF)
194)	Red Knot (REKN)
195)	Sanderling (SAND)
196)	Semipalmated Sandpiper (SESA)
197)	Western Sandpiper (WESA)
198)	Rufous-necked Stint (RNST)
199)	Least Sandpiper (LESA)
200)	White-rumped Sandpiper (WRSA)
201)	Baird's Sandpiper (BASA)
202)	Pectoral Sandpiper (PESA)
203)	Sharp-tailed Sandpiper (SHSA)
204)	Rock Sandpiper (ROSA)
205)	Dunlin (DUNL)
206)	Curlew Sandpiper (CUSA)
207)	Stilt Sandpiper (STSA)
208)	Buff-breasted Sandpiper (BBSA)
209)	Ruff (RUFF)
210)	Short-billed Dowitcher (SBDO)
211)	Long-billed Dowitcher (LBDO)
212)	Common Snipe (COSN)
213)	Wilson's Phalarope (WIPH)
214)	Red-necked Phalarope (RNPL)
215)	Red Phalarope (REPH)
216)	unidentified sandpiper (sdpp)
217)	unidentified shorebird (shor)

No.	SPECIES (CODE)
Gulls and Terns	
218)	Pomarine Jaeger (POJA)
219)	Parasitic Jaeger (PAJA)
220)	Long-tailed Jaeger (LTJA)
221)	South Polar Skua (SPSK)
222)	Franklin's Gull (FRGU)
223)	Little Gull (LIGU)
224)	Bonaparte's Gull (BOGU)
225)	Heermann's Gull (HEEG)
226)	Mew Gull (MEGU)
227)	Ring-billed Gull (RBGU)
228)	California Gull (CAGU)
229)	Herring Gull (HEGU)
230)	Thayer's Gull (THGU)
231)	Western Gull (WEGU)
232)	Glaucous-winged Gull (GWGU)
233)	Glaucous Gull (GLGU)
234)	Great Black-backed Gull (GBBG)
235)	Black-legged Kittiwake (BLKI)
236)	Sabine's Gull (SAGU)
237)	Ivory Gull (IVGU)
238)	unidentified gull (gull)
239)	Caspian Tern (CATE)
240)	Elegant Tern (ELTE)
241)	Common Tern (CMTE)
242)	Arctic Tern (ARTE)
243)	Forster's Tern (FOTE)
244)	Aleutian Tern (ALTE)
245)	Black Tern (BLTE)
246)	unidentified tern (tern)
Alcids	
247)	Pigeon Guillemot (PIGU)
248)	Marbled Murrelet (MAMU)
249)	Kittlitz's Murrelet (KIMU)
250)	Xantus Murrelet (XAMU)
251)	Ancient Murrelet (ANMU)
252)	unidentified alcid (alcd)
Pigeons and Doves	
253)	Rock Dove (RODO)
254)	Band-tailed Pigeon (BTPI)
255)	Mourning Dove (MODO)
256)	unidentified pigeon/dove (dove)
Cuckoos	
257)	Black-billed Cuckoo (BBCU)
Owls	
258)	Barn Owl (BNOW)
259)	Flammulated Owl (FLOW)
260)	Western Screech-Owl (WSOW)
261)	Great Horned Owl (GHOW)
262)	Snowy Owl (SNOW)
263)	Northern Hawk Owl (NHOW)
264)	Northern Pygmy-Owl (NPOW)
265)	Burrowing Owl (BUOW)
266)	Spotted Owl (SPOW)
267)	Barred Owl (BAOW)
268)	Great Gray Owl (GGOW)
269)	Long-eared Owl (LEOW)
270)	Short-eared Owl (SEOW)
271)	Boreal Owl (BOOW)
272)	Northern Saw-whet Owl (NSWO)

No.	SPECIES (CODE)
Owls (continued)	
273)	unidentified large owl (lowl)
274)	unidentified small owl (sowl)
275)	unidentified owl (owlg)
Goatsuckers	
276)	Common Nighthawk (CONI)
277)	Common Poorwill (COPO)
Swifts and Hummingbirds	
278)	Black Swift (BLSW)
279)	Vaux's Swift (VASW)
280)	White-throated Swift (WTSW)
281)	unidentified swift (swft)
282)	Ruby-throated Hummingbird (RTHU)
283)	Black-chinned Hummingbird (BCHU)
284)	Anna's Hummingbird (ANHU)
285)	Costa's Hummingbird (COHU)
286)	Calliope Hummingbird (CAHU)
287)	Rufous Hummingbird (RUHU)
288)	unidentified hummingbird (humm)
Kingfishers	
289)	Belted Kingfisher (BEKI)
Woodpeckers	
290)	Lewis' Woodpecker (LEWO)
291)	Yellow-bellied Sapsucker (YBSA)
292)	Red-naped Sapsucker (RNSA)
293)	Red-breasted Sapsucker (RBSA)
294)	Williamson's Sapsucker (WISA)
295)	Downy Woodpecker (DOWO)
296)	Hairy Woodpecker (HAWO)
297)	White-headed Woodpecker (WHWO)
298)	Three-toed Woodpecker (TTWO)
299)	Black-backed Woodpecker (BBWO)
300)	Northern Flicker (NOFL)
301)	Pileated Woodpecker (PIWO)
302)	unidentified woodpecker (wdpk)
Flycatchers	
303)	Olive-sided Flycatcher (OSFL)
304)	Western Wood-Pewee (WWPE)
305)	Yellow-bellied Flycatcher (YBFL)
306)	Acadian Flycatcher (ACFL)
307)	Alder Flycatcher (ALFL)
308)	Willow Flycatcher (WIFL)
309)	Least Flycatcher (LEFL)
310)	Hammond's Flycatcher (HAFL)
311)	Dusky Flycatcher (DUFL)
312)	Gray Flycatcher (GRFL)
313)	Pacific-slope Flycatcher (PSFL)
314)	Black Phoebe (BLPH)
315)	Eastern Phoebe (EAPH)
316)	Say's Phoebe (SAPH)
317)	Ash-throated Flycatcher (ATFL)
318)	Tropical Kingbird (TRKI)
319)	Thick-billed Kingbird (TBKI)
320)	Western Kingbird (WEKI)
321)	Eastern Kingbird (EAKI)
322)	Gray Kingbird (GRKI)
323)	Scissor-tailed Flycatcher (STFL)
324)	unidentified flycatcher (flyc)

No.	SPECIES (CODE)
Larks	
325)	Eurasian Skylark (ESKY)
326)	Horned Lark (HOLA)
Swallows	
327)	Purple Martin (PUMA)
328)	Tree Swallow (TRSW)
329)	Violet-green Swallow (VGSW)
330)	Northern Rough-winged Swallow (NRWS)
331)	Bank Swallow (BKSW)
332)	Cliff Swallow (CLSW)
333)	Barn Swallow (BASW)
334)	unidentified swallow (swal)
Jays, Crows and Magpies	
335)	Gray Jay (GRJA)
336)	Steller's Jay (STJA)
337)	Blue Jay (BLJA)
338)	Scrub Jay (SCJA)
339)	unidentified jay (ujay)
340)	Clark's Nutcracker (CLNU)
341)	Black-billed Magpie (BBMA)
342)	American Crow (AMCR)
343)	Northwestern Crow (NOCR)
344)	unidentified crow (crow)
345)	Common Raven (CORA)
Chickadees and Bushtits	
346)	Black-capped Chickadee (BCCH)
347)	Mountain Chickadee (MOCH)
348)	Boreal Chickadee (BOCH)
349)	Chestnut-backed Chickadee (CBCH)
350)	unidentified chickadee (cdee)
351)	Bushtit (BUSH)
Nuthatches and Creepers	
352)	Red-breasted Nuthatch (RBNU)
353)	White-breasted Nuthatch (WBNU)
354)	Pygmy Nuthatch (PYNU)
355)	unidentified nuthatch (nuha)
356)	Brown Creeper (BRCR)
Wrens and Dippers	
357)	Rock Wren (ROWR)
358)	Canyon Wren (CAWR)
359)	Bewick's Wren (BEWR)
360)	House Wren (HOWR)
361)	Winter Wren (WIWR)
362)	Marsh Wren (MAWR)
363)	unidentified wren (wren)
364)	American Dipper (AMDI)
Kinglets, Bluebirds and Thrushes	
365)	Golden-crowned Kinglet (GCKI)
366)	Ruby-crowned Kinglet (RCKI)
367)	Blue-gray Gnatcatcher (BGGN)
368)	Northern Wheatear (NOWH)
369)	Western Bluebird (WEBL)
370)	Mountain Bluebird (MOBL)
371)	unidentified bluebird (blue)
372)	Townsend's Solitaire (TOSO)
373)	Veery (VEER)
374)	Gray-cheeked Thrush (GCTH)
375)	Swainson's Thrush (SWTH)

No.	SPECIES (CODE)
Kinglets, Bluebirds and Thrushes (continued)	
376)	Hermit Thrush (HETH)
377)	American Robin (AMRO)
378)	Varied Thrush (VATH)
379)	unidentified thrush (thsh)
Mockingbirds and Thrashers	
380)	Gray Catbird (GRCA)
381)	Northern Mockingbird (NOMO)
382)	Sage Thrasher (SATH)
383)	Brown Thrasher (BRTH)
Wagtails and Pipits	
384)	Yellow Wagtail (YEWG)
385)	Black-backed Wagtail (BBWG)
386)	Red-throated Pipit (RTPI)
387)	Water Pipit (WAPI)
Waxwings	
388)	Bohemian Waxwing (BOWA)
389)	Cedar Waxwing (CEWA)
Shrikes	
390)	Northern Shrike (NOSH)
391)	Loggerhead Shrike (LOSH)
Starlings	
392)	European Starling (EUST)
393)	Crested Myna (CRMY)
Vireos	
394)	Solitary Vireo (SOVI)
395)	Hutton's Vireo (HUVI)
396)	Warbling Vireo (WAVI)
397)	Philadelphia Vireo (PHVI)
398)	Red-eyed Vireo (REVI)
399)	unidentified vireo/warbler (viwa)
Warblers and Allies	
400)	Tennessee Warbler (TEWA)
401)	Orange-crowned Warbler (OCWA)
402)	Nashville Warbler (NAWA)
403)	Yellow Warbler (YEWA)
404)	Chestnut-sided Warbler (CSWA)
405)	Magnolia Warbler (MAWA)
406)	Cape May Warbler (CMWA)
407)	Black-throated Blue Warbler (BTBW)
408)	Yellow-rumped Warbler (YRWA)
409)	Black-throated Gray Warbler (BTGW)
410)	Townsend's Warbler (TOWA)
411)	Black-throated Green Warbler (BTNW)
412)	Blackburnian Warbler (BLWA)
413)	Palm Warbler (PAWA)
414)	Bay-breasted Warbler (BBWA)
415)	Blackpoll Warbler (BPWA)
416)	Black-and-White Warbler (BAWW)
417)	American Redstart (AMRE)
418)	Ovenbird (OVEN)
419)	Northern Waterthrush (NOWA)
420)	Connecticut Warbler (COWA)
421)	Mourning Warbler (MOWA)
422)	MacGillivray's Warbler (MGWA)
423)	Common Yellowthroat (COYE)
424)	Wilson's Warbler (WIWA)
425)	Canada Warbler (CAWA)

No.	SPECIES (CODE)
Warblers and Allies (continued)	
426)	Painted Redstart (PARE)
427)	Yellow-breasted Chat (YBCH)
428)	Scarlet Tanager (SCTA)
429)	Western Tanager (WETA)
430)	Rose-breasted Grosbeak (RBGR)
431)	Black-headed Grosbeak (BHGR)
432)	Lazuli Bunting (LZBU)
433)	Indigo Bunting (INBU)
434)	Dickcissel (DICK)
Sparrows and Allies	
435)	Green-tailed Towhee (GGTO)
436)	Rufous-sided Towhee (RSTO)
437)	American Tree Sparrow (ATSP)
438)	Chipping Sparrow (CHSP)
439)	Clay-colored Sparrow (CCSP)
440)	Brewer's Sparrow (BRSP)
441)	Vesper Sparrow (VESP)
442)	Lark Sparrow (LASP)
443)	Black-throated Sparrow (BTSP)
444)	Sage Sparrow (SASP)
445)	Lark Bunting (LABU)
446)	Savannah Sparrow (SAVS)
447)	Baird's Sparrow (BASP)
448)	Grasshopper Sparrow (GRSP)
449)	Le Conte's Sparrow (LCSP)
450)	Sharp-tailed Sparrow (STSP)
451)	Fox Sparrow (FOSP)
452)	Song Sparrow (SPSP)
453)	Lincoln's Sparrow (LISP)
454)	Swamp Sparrow (SWSP)
455)	White-throated Sparrow (WTSP)
456)	Golden-crowned Sparrow (GCSP)
457)	White-crowned Sparrow (WCSP)
458)	Harris' Sparrow (HASP)
459)	unidentified sparrow (spar)
460)	Dark-eyed Junco (DEJU)
461)	unidentified junco (jnco)
462)	McCown's Longspur (MCLO)
463)	Lapland Longspur (LALU)
464)	Smith's Longspur (SMLO)
465)	Chestnut-collared Longspur (CCLO)
466)	Rustic Bunting (RUBU)
467)	Snow Bunting (SNBU)
468)	McKay's Bunting (MCBU)
Blackbirds and Allies	
469)	Bobolink (BOBO)
470)	Red-winged Blackbird (RWBL)
471)	Western Meadowlark (WEME)
472)	Yellow-headed Blackbird (YHBL)
473)	Rusty Blackbird (RUBL)
474)	Brewer's Blackbird (BRBL)
475)	Great-tailed Grackle (GTGR)
476)	Common Grackle (COGR)
477)	Brown-headed Cowbird (BHCO)
478)	Northern Oriole (NOOR)
479)	unidentified blackbird (blkb)
Finches	
480)	Brambling (BRAM)
481)	Rosy Finch (ROFI)

No.	SPECIES (CODE)
Finches (continued)	
482)	Pine Grosbeak (PIGR)
483)	Purple Finch (PUFI)
484)	Cassin's Finch (CAFI)
485)	House Finch (HOFI)
486)	Red Crossbill (RECR)
487)	White-winged Crossbill (WWCR)
488)	Common Redpoll (CORE)
489)	Hoary Redpoll (HORE)
490)	Pine Siskin (PISI)
491)	Lesser Goldfinch (LEGO)
492)	American Goldfinch (AMGO)
493)	Evening Grosbeak (EVGR)
494)	unidentified finch (fnch)
495)	House Sparrow (HOSP)
496)	unidentified passerine (pass)
497) Unidentified Bird (unbd)	
MAMMALS	
Marsupials	
498)	North American Opossum (DIVI)
Shrews and Moles	
499)	Black-backed Shrew (SOAR)
500)	Pacific Water Shrew (SOBE)
501)	Common Shrew (SOCI)
502)	Pygmy Shrew (SOHO)
503)	Dusky Shrew (SOMO)
504)	Water Shrew (SOPA)
505)	Trowbridge's Shrew (SOTR)
506)	Tundra Shrew (SOTU)
507)	Vagrant Shrew (SOVA)
508)	unidentified shrew (unsh)
509)	Shrew Mole (NEGI)
510)	Coast Mole (SCOR)
511)	Townsend's Mole (SCTO)
512)	unidentified mole (mole)
Bats	
513)	Big Free-tailed Bat (NYMA)
514)	Pallid Bat (ANPA)
515)	Big Brown Bat (EPFU)
516)	Spotted Bat (EUMA)
517)	Silver-haired Bat (LANO)
518)	Southern Red Bat (LABO)
519)	Hoary Bat (LACI)
520)	California Myotis (MYCA)
521)	Western Small-footed Myotis (MYCI)
522)	Western Long-eared Myotis (MYEV)
523)	Keen's Long-eared Myotis (MYKE)
524)	Little Brown Myotis (MYLU)
525)	Northern Long-eared Myotis (MYSE)
526)	Fringed Myotis (MYTH)
527)	Long-legged Myotis (MYVO)
528)	Yuma Myotis (MYYU)
529)	Townsend's Big-eared Bat (PLTO)
530)	unidentified bat (unbt)
Rabbits, Hares and Pikas	
531)	Snowshoe Hare (LEAM)
532)	White-tailed Jack Rabbit (LETO)
533)	European Rabbit (ORCU)
534)	Eastern Cottontail (SYFL)

No.	SPECIES (CODE)
Rabbits, Hares and Pikas (continued)	
535)	Nuttall's Cottontail (SYNU)
536)	unidentified hare/rabbit (unhf)
537)	Collared Pika (OCCO)
538)	Common Pika (OCPR)
Mountain Beavers	
539)	Mountain Beaver (APRU)
Voles and Lemmings	
540)	Southern Red-backed Vole (CLGA)
541)	Northern Red-backed Vole (CLRU)
542)	unidentified red-backed vole (rbvo)
543)	Brown Lemming (LESI)
544)	Long-tailed Vole (MILO)
545)	Montane Vole (MIMO)
546)	Tundra Vole (MIOE)
547)	Creeping Vole (MIOR)
548)	Meadow Vole (MIPE)
549)	Water Vole (MIRI)
550)	Townsend's Vole (MITO)
551)	field vole, general (micr)
552)	Muskrat (ONZI)
553)	Heather Vole (PHIN)
554)	Northern Bog Lemming (SYBO)
555)	unidentified "mouse" (unro)
Beavers	
556)	Beaver (CACA)
New World Mice and Rats	
557)	Bushy-tailed Woodrat (NECI)
558)	Deer Mouse (PEMA)
559)	Columbian Mouse (PEOR)
560)	Sitka Mouse (PESI)
561)	Western Harvest Mouse (REME)
Miscellaneous Rodents	
562)	Porcupine (ERDO)
563)	Northern Pocket Gopher (THTA)
564)	Great Basin Pocket Mouse (PEPA)
Old World Mice and Rats	
565)	House Mouse (MUMU)
566)	Norway Rat (RANO)
567)	Black Rat (RARA)
Myocastorids	
568)	Nutria (MYCO)
Sciurids (Marmots, Squirrels and Chipmunks)	
569)	Northern Flying Squirrel (GLSA)
570)	Hoary Marmot (MACA)
571)	Yellow-bellied Marmot (MAFL)
572)	Woodchuck (MAMO)
573)	Vancouver Island Marmot (MAVA)
574)	unidentified marmot (marm)
575)	Gray Squirrel (SCCA)
576)	Fox Squirrel (SCNI)
577)	unidentified tree squirrel (trsq)
578)	Columbian Ground Squirrel (SPCO)
579)	Golden-mantled Ground Squirrel (SPLA)
580)	Arctic Ground Squirrel (SPPA)
581)	Cascade Mantled Ground Squirrel (SPST)
582)	unidentified ground squirrel (gdsq)
583)	Yellow-pine Chipmunk (TAAM)
584)	Least Chipmunk (TAMI)
585)	Red-tailed Chipmunk (TARU)

No.	SPECIES (CODE)
Sciurids (continued)	
586)	Townsend's Chipmunk (TATO)
587)	unidentified chipmunk (cpmk)
588)	Douglas' Squirrel (TADO)
589)	Red Squirrel (TAHU)
Jumping Mice	
590)	Meadow Jumping Mouse (ZAHU)
591)	Western Jumping Mouse (ZAPR)
592)	Pacific Jumping Mouse (ZATR)
Canids	
593)	Coyote (CALA)
594)	Gray Wolf (CALU)
595)	Red Fox (VUVU)
596)	unidentified canid (undf)
Felids	
597)	Cougar (FECO)
598)	Lynx (LYCA)
599)	Bobcat (LYRU)
600)	unidentified felid (uncf)
Weasels and Allies	
601)	Wolverine (GUGU)
602)	River Otter (LOCA)
603)	Marten (MAAM)
604)	Fisher (MAPE)
605)	Striped Skunk (MEME)
606)	Ermine (MUER)
607)	Long-tailed Weasel (MUFR)
608)	Least Weasel (MUNI)
609)	unidentified weasel (unwe)
610)	Mink (MUVI)
611)	Spotted Skunk (SPPU)
612)	Badger (TATA)
Pinnipeds (Seals and Sea Lions)	
613)	Northern Sea Lion (EUJU)
614)	Harbor Seal (PHVT)
615)	unidentified pinniped (seal)
Procyonids	
616)	Raccoon (PRLO)
Bears	
617)	Black Bear (URAM)
618)	Grizzly Bear (URAR)
619)	unidentified bear (bear)
620)	unidentified carnivore (unca)
Ungulates	
621)	Bison (BIBI)
622)	Mountain Goat (ORAM)
623)	Bighorn Sheep (OVCA)
624)	Thinhorn Sheep: Dall and Stone Sheep (OVDA)
625)	Moose (ALAL)
626)	Fallow Deer (CEDA)
627)	Elk (CEEL)
628)	Mule and Black-tailed Deer (ODHE)
629)	White-tailed Deer (ODVI)
630)	Caribou (RATA)
631)	unidentified deer (deer)
632)	unidentified ungulate (unun)
633)	***Unidentified Mammal (unma)***
634)	***Unidentified Vertebrate (unvv)***